Railroad Age Gazette

DAILY EDITION

Vol. XLVI. NEW YORK—JUNE 18, 1909—ATLANTIC CITY. No. 25A.

PUBLISHED DAILY BY
THE RAILROAD GAZETTE (INC.), 83 FULTON STREET, NEW YORK
On the occasion of the Annual Conventions of the Master Car Builders' and American Railway Master Mechanics' Associations.

CHICAGO: 160 Harrison St. PITTSBURGH: Farmers' Bank Bldg.
LONDON: Queen Anne's Chambers, Westminster.

W. H. BOARDMAN, *President and Editor.*
E. A. SIMMONS, *Vice-President.* RAY MORRIS, *Sec'y and Man'g Editor.*
R. S. CHISOLM, *Treasurer.*
The address of the company is the address of the officers.

Subscription, including regular weekly issues and special daily editions published from time to time in New York, or in places other than New York, payable in advance and postage free.

United States and Mexico.....$5.00 a year
Canada .....$6.00 a year
Foreign Edition, London.....£1 12*s.* ($8.00) a year
Single Copies.....15 cents each

If mailed from Atlantic City the postage on this copy of the *Daily Railroad Age Gazette* is seven cents. Unless the full amount is affixed to the wrapper or envelope, the post office will not forward the paper.

Application made at the Post Office at New York for entry as mail matter of the second class.

The letter in another column from "A Railway Supplyman" merits attention and serious consideration. In strengthening the building the very best available timber should be used; and the present organization contains plenty of satisfactory material. It does not follow, however, that a man's title makes him a fit candidate, but those chosen for both president and vice-president should reflect all that is typical of the men whom railway officers most respect—and this is said without specific reference to any of the names that have been mentioned at this writing.

It was made pretty evident, in the discussion on motor cars, that they are all right mechanically, and can be worked to good advantage in the right place. But it is quite as necessary that the place should be suited to the motor as that the motor should be fitted for its work. It will probably surprise some people to be told that the places that are particularly well suited to motor car operation are comparatively few and are separated at wider intervals than most people suppose. And yet in spite of this there is undoubtedly a wide field open for their introduction and use.

The reports for both associations were sent out in good time this year and most of the members have the advantage of an opportunity to lead them before coming to the convention, and this assists materially in the value and intent of the discussions. The habit of promptness should be cultivated in this particular, and the Committee on the "Revision of the Constitution and By-Laws" has taken account of it in a manner which should insure printed reports well in advance of the Conventions. Article XI of the revised By-Laws will read "Committee reports which do not reach the secretary in time for printing and issuing by May 1, will be referred to the Executive Committee to decide whether the report shall be submitted to the Convention."

Two of the Master Mechanics' reports, the one on superheaters, and one on safety valves, are very brief, and the reason given is the depression in business during the past year which has discouraged the expenditure of money for experimental work. This shows the extent to which reduction in expenses was carried by the railways when their revenues fell off rapidly. It is doubtful if such extreme measures of economy are wise. Objections are made to experiments in prosperous times because they may interfere with the regular business, which is earning money, or for the reason that everyone is fully occupied attending to the large volume of traffic on hand and there is no place for unproductive employment. The dull times are most favorable for experiment and research for these reasons, and the slight expenditure required for determining the proper size and capacity of locomotive safety valves, when distributed among a large number of railways, would not be felt. The economies which are certain to follow the use of a good superheater in locomotive practice are so important that the railways cannot afford to let a year go by without showing substantial advance in the development necessary to make them successful in American practice. The Santa Fe has been enterprising enough to go ahead in this work on its own account and it has already obtained such satisfactory results as to warrant the construction of a large number of superheaters.

MECHANICAL STOKERS.

The necessity for a mechanical stoker for locomotives is gradually forcing itself upon the attention of master mechanics, and the number in use is gradually increasing. The most notable installation at present is that on the Alton where a number of Strouse stokers are in use on their heavy new locomotives. This stoker was described in a report of the Master Mechanics' standing committee on Mechanical Stokers at the convention last year. It is in the hands of a business-like management and is working on the Alton engines under such favorable conditions that it promises to obtain a permanent foothold. It is the first to be adopted and used in large numbers.

The experiments with the Crosby stoker on the Chicago & North Western have not been so successful as to warrant further development, and the further use of the Victor stoker has ceased. The Pennsylvania has been experimenting with an underfed stoker of its own design on the Lines West, under the direction of D. F. Crawford, and thus far it is giving satisfactory results. The development of the Barnum underfed stoker on the Burlington is still in progress.

One of the principal advantages of the mechanical stoker is its capacity for continuous work and by firing a larger amount of coal in a given time, it is able to maintain full boiler pressure over the whole division, and thus insure the arrival of the train at terminal on schedule time; and usually in freight service it will largely reduce the time ordinarily required when the engine is fired by hand. The mechanical stoker does not expose the firemen to the full glare and heat from the open firedoor, and it relieves him from the labor of throwing the coal forward into the box, but it is still necessary to keep the hopper full, and if a larger amount of fuel is fired it requires him to handle this extra weight.

If the principal advantage of the automatic stoker, viz., larger capacity, is to be availed of, it is evident that the fireman must be assisted in handling the larger amount of coal to the stoker, and the use of a power conveyor is at once suggested. The Hayden stoker, used on the Erie, was equipped with a conveyor which gave satisfactory service. Another stoker with conveyor attachment has recently been designed by J. J. Marshall, Shelburne, Ont., Canada, in which the conveyor is more compact and not as elaborate as the Hayden. It consists of one circular chute, hinged at the bottom at the front of the tank and inclined so as to reach the top of the hopper at the fire door. The chute contains a spiral conveyor, which is operated by a separate engine, and is somewhat similar to the Black or Dodge conveyor illustrated in this ...'s report of

the stoker committee. The Marshall stoker is like the Hayden in that it uses steam jets for projecting the coal into the firebox, but unlike the Hayden, these jets are not operated automatically. They are each connected with a steam valve, and each valve is operated by a hand lever, thus requiring the almost constant attention of the fireman.

"SUBMITTED TO THE AMERICAN RAILWAY ASSOCIATION."

In the proposed amendments to the M. C. B. constitution there is an ominous suggestion. It is the more dangerous because it is insidious. In Article II it is prescribed that some subjects may be "submitted" to the American Railway Association. In Article VI it is made the duty of the executive committee to decide what subjects to withdraw from M. C. B. consideration, and to refer them to the American Railway Association. This is not the first attempt that has been made to establish relations with this association of ranking officers, justifiable possibly if that association had a record of effectiveness, but pitiable in view of its masterful and suppressing inactivity.

The American Railway Association, during the years when it was known as the General Time Convention, monotonously performed its common-law duty in adjusting trunk line timetables. During the past generation one of its committees has gradually developed a code of train rules which are understandable. It has acted as foster parent to a few strong propositions coming from men who would not be ignored; such as Sir Sanford Fleming and W. F. Allen, and the adoption of standard time, Arthur Hale with his methods for increasing car efficiency, and Dr. Dudley for safe transportation of explosives. It permitted one of its committees to use the Association's name in making a deadly exhibit of the bad quality of rails, but this only when closely pressed by such a man as W. J. Wilgus and by the publication of unanswerable photographs and statistics in these columns.

Compare this meager record with what might have been reasonably expected from a compact organization of the highest officers of American railways. It might act as a live connection between all railways, all railway departments and between railways and the public. With frankness, instead of mystery; by taking the initiative in the enforcement of law and stopping rebating by its members; by standardizing its accounts and statistics instead of dully resisting the professor employed by the Interstate Commerce Commission; by making public all accident records and determining their causes in a judicial manner and in a way to secure public confidence and reduce accidents, as is done on the Harriman lines—with earnestness and serious purpose in these fields of usefulness the American Railway Association has the talent and the power to unify the work of all the railways for better public service; to remove all provocation for hostile legislation and paralyze demagogues and agitators.

But the American Railway Association is a Negative. It has never been very effective, and it is now tentatively proposed to envelop the most effective railway association in the land with its sable pall.

Since the organization of the M. C. B. Association with a representative membership, it has grown steadily in value to the railways, both in its discussions and in its decisions. A true statement was made in a paper in 1903 on the work of its arbitration committee: "The whole history of its rulings has been an unbroken record of consistency, equity and justice." Its standards are really, if not always, theoretically, enforced, and legislatures await its decisions before passing laws affecting car constuction and operation. Its proceedings form a library on the railroad car that is unequalled in scope and value.

A merging with the Master Mechanics' Association, having so many studies and problems in common, may well be considered to the end of a greater usefulness for both, but a step toward subordinating the most influential technical organization in the world to the deadening influence of an inert association of superior officers is unmanly. It should make its members blush.

THE DISCUSSION OF MECHANICAL STOKERS.

The discussion on mechanical stokers showed that a decided interest is now being taken on the subject, and the sentiment is largely in favor of their use. The successful operation of the Strouse stoker on the Alton was described by a number of members who had watched the performance, and there was abundant testimony to the fact that it was now beyond the experimental stage. After two months' service the repair item was very light, and the stoker would operate for one month without any repairs. The advantage in reducing smoke is very little, and the spark loss must be rather large, owing to the nature of the coal and the spraying action of the stoker. It was reported that on a trip from Bloomington, Ill., to Chicago on a large consolidation engine the coal consumption was 22 tons, and at the end of the trip there was little ash in the pan and but a small amount of coal in the firebox. As Illinois coal contains nearly 10 per cent. ash the question arises what became of nearly one ton of ash resulting from the combustion of the 22 tons of coal used? This coal is rather friable, produces little clinker and when sprayed into the hot firebox the finer portions burn before they lodge on the firebed and the lighter portions are drawn directly through the tubes while burning. In this way they give out a portion of their heat and either bank up in the smoke box or are discharged from the stack. There is little or no clinker to stop up the grates or accumulate in the ashpan. The coal is well adapted to the use of a mechanical stoker, but with the heavy blast necessary for full boiler capacity it does not seem possible to show any economy of fuel resulting from the use of the stoker.

The most important advantage of the mechanical stoker is the increase in the capacity of the boiler which it makes possible and the experience on the Alton gives abundant proof to the realization of this claim.

Mr. Henderson's discussion also shows by calculation that the large Mallet locomotives when worked to fair capacity should burn 15,000 lbs. of coal per hour, which would require either two firemen or a mechanical stoker, and the latter would be the cheaper and more desirable. It is to be regretted that the reported tests of the Hayden stoker were not made with a wider range in the quality of the coal. It is also unfortunate that, in the selection of the coals, the best quality was selected for the test. But this unfortunate oversight aside, it is quite evident that those who have had to do with stokers are convinced of the practicability of the device, and believe that as soon as mechanical stokers are put upon locomotives as a dependable mechanism their development as coal savers and smoke preventers will follow. It has been known for a number of years that a stoker could be made to maintain the steam pressure, but this is evidently only a part of the problem of its development.

DISCUSSION OF MR. NELSON'S PAPER

In the discussion of Mr. Nelson's paper on bank versus level firing it was shown that the tests were made for a specific purpose, and the results had application only to the particular conditions surrounding the test. The doubt was immediately raised whether the conclusions had general application. Special emphasis was placed on the influence of the shape of the firebox and the quality of the coal, either of which if very different from those used in the test might have given entirely different results. It is usually found in such matters that the established practice is most likely to be the best and that if in one place bank firing is the rule it is probable that general conditions make it the best.

As pointed out by the author, the bank must not be too high, or that kind of firing will be uneconomical.

It is difficult to understand how the full capacity of the boiler was obtained in the tests when a thick fire was carried at the back end and a very thin one in front, for in that case most of the air supply came through the front of the grate. The explanation which suggests itself is that the air supply for the coal at the rear came through the fire door through the small holes when closed and through the full opening when the door was open for firing. The coal bank at the rear was burned by air supply on top instead of below and through the coal as usual.

LOCOMOTIVE SAFETY VALVES.

The monthly meetings of the American Society of Mechanical Engineers, at which usually only one subject is discussed, have on several occasions demonstrated their special value to the profession; and that of February, 1909, at which "Safety Valves" was the subject, resulted in an unusually valuable contribution to our knowledge of this important boiler fixture.

At this meeting two papers on "Safety Valves" were presented, one by F. M. Whyte, which deals more particularly with locomotive conditions and requirements, and one by Philip G. Darling, on "Safety Valve Capacity," which gave the results of tests of valves on stationary boilers and on a locomotive at the Burnside shops of the Illinois Central. The subject was fully discussed by prominent engineers and manufacturers and the proceedings of the meeting cover 60 pages. This fund of information relating to safety valve capacity, formulas and design must have been of considerable assistance to the committee in the preparation of their report. There was a general feeling that existing rules relating to safety valves were not satisfactory, and here was an unusual opportunity for useful research work.

It was suggested that the boiler insurance companies should undertake such an investigation, and it is apparent that owing to the peculiar conditions surrounding locomotive boilers, a special research should be conducted by and under the direction of the Master Mechanics' Association. Mr. Whyte pointed out that the size of locomotive valves is to-day an uncertain matter, and the life which is necessary to give an indication of the capacity has been entirely ignored. To know the capacity of a valve is not even sufficient; but it is quite important to know how much steam is to be released and in what time it should be released. It was suggested that in rating safety valves the small diameter of the seat be used, as that determines the area open to the steam pressure when the valve is closed.

Quite a difference of opinion exists as to the proper lift, some favoring a large lift and others a small one. The tests on the Illinois Central were made on a consolidation locomotive having 50 sq. ft. of grate area and 2,953 sq. ft. of heating surface. The calculated evaporation averaged 6,060 lbs. and minimum evaporation 11,050 lbs. per hour. It was found that there was a variation of 300 per cent. in the lift of six standard valves of the same size (3½ in.) but of different makes. Under existing official rules these valves, some with less than one-third the lift and capacity of others, receive the same rating and are listed as of equal relieving value. The lowest life valve had .04 in. at the opening and .023 in. at the closing, and the highest 14 in. at the opening and .102 in. at the closing. Objection has been made to high lift valves on account of their action in relieving the boiler too suddenly and creating a lower pressure at which a large volume of water will be converted into steam. The effect of a sudden opening or closing is to produce a shock, and it disturbs the water level to the extent that more water is taken over into the cylinders. The difference in lift which produces such results is probably less than $\frac{1}{16}$ in., $\frac{1}{8}$ in. being regarded as a high lift for locomotive valve and $\frac{1}{16}$ the usual size, which has been the common standard. It was generally agreed that the capacity of safety valves should be based on heating surface and some effort should be made to equate firebox and tube surface.

In Mr. Darling's paper, the following formula was recommended for determining the proper diameter of the valve: $D = C \times \frac{\quad}{\quad}$ where C is constant .055, which has been determined experimentally for locomotives. H, the total heating surface in square feet. L, the lift in inches. P, absolute boiler pressure. This formula is evidently based on total heating surface, as simply the arithmetical sum of the firebox surface and the tube surface, but should be modified to suit a more rational equation of these two items. While there is not a great variation in the firebox surface in locomotives of equal capacity, the length of tubes varies from 10 ft. to 21 ft., and spacing from ¾ in. to 1 in., and a boiler with long tubes spaced close together would have a comparatively large tube surface compared with another with short tubes and equal firebox surface. While nothing exact can be done to equate those, yet an arbitrary figure even if not exact for the comparative value of firebox surface would be much better than the assumption that tube and firebox surface are equal in rating boiler capacity.

While definite rules for the size and number of safety valves for locomotives are desirable, it is evident that on account of the conditions governing the draft on locomotives, the same necessity does not exist for safety valve regulations as in the case of marine of stationary boilers, the action of the exhaust on locomotives automatically taking care in a large measure of the generation of steam. When oil is used for fuel on locomotives the conditions are different and the generation of steam is not so much dependent on the exhaust blast, as the pressure of steam from the burner is sufficient to keep up active combustion and steam generation after the throttle is closed. If the oil burner is not carefully regulated and nearly closed when the engine stops, or when the throttle is closed while drifting down a grade, there is danger of continued production of steam and an excess pressure which calls for proper regulation by the safety valve.

With coal as fuel, the automatic regulation of draft to steam consumption makes the exact size of the locomotive safety valve of less importance and the wide range possible is indicated by foreign practice. The Ramsbottom duplex safety valve is used almost universally in England and with the exception of America, throughout the world. When introduced on the London & North Western Railway in 1858 they were made 3 in. in diameter and this size is still used, although the boiler capacity and pressure have since been increased 50 per cent.

Locomotive safety valves are usually regarded as merely an instrument to indicate that more water should be ejected or less fuel used, and the careful engineer does not allow the safety valve to lift frequently. Assuming that some visible or audible indication of maximum boiler pressure is desired, it has been suggested that a simmering valve could be used, one which will open slightly for two or three pounds about the normal maximum, and then open full, reversing this in closing.

Two items in the Secretary's report are of special interest. The one relating to the Master Mechanics Scholarships gives encouraging reports of the high standing of the young men in their studies, and the larger number of applicants assures the filling of the whole number of scholarships offered. The association is doing a good work in securing a good engineering education to the sons of quite a number of its members and it should have its proper reward when these men become active members, and add to the usefulness of the association. The second item relates to the Tillotson bequest which makes the interest on $5,000 available for research and investigation of questions relating to locomotive performance and operation.

This bequest by one of the old members who was scarcely known to many of the present members suggests the possibility of obtaining more money for such a fund in a similar

way. While the Master Mechanics are not as a rule regarded as men of wealth, yet quite a number of them have accumulated a comfortable competence, and in some instances there may not be a family to inherit their small fortune. If it were more generally known that such funds could be usefully employed in conducting experiments and in making investigations in regard to unsettled questions, which continually come up in the work of the conventions, other members might find some pride and pleasure in providing a similar bequest in their wills. It might be well for the association to give notice that such contributions will be gladly received.

THE SUPPLY MANUFACTURERS' ELECTION.

June 14, 1909.

TO THE EDITOR OF THE DAILY RAILROAD AGE GAZETTE:

Only a small minority of supply men realize that a grave crisis is impending in their association this year. The majority do not know what we are "up against," for they show very little enthusiasm and interest in the organization proper. They seem to think that when they have paid their dues and arranged their exhibits, work incidental to the Railway Manufacturers' Association has been accomplished. Being a good fellow and throwing the glad hand to railway men are personal matters, of course.

Upon the establishment of the permanent exhibit feature of the Master Mechanics' and Master Car Buliders' conventions it becomes necessary to install some sort of an organization or committee to take charge of the arrangements of the exhibitors. This, everyone agreed, was necessary, because of the rapid growth in size of exhibits and increasing number of exhibitors, and it seemed fitting that one man, the secretary, should have general supervision of the arrangement of the exhibits, etc., another man, the president or chairman, to have the general oversight of the business and social arrangements with such assistants as were necessary. All these arrangements seemed to have run along smoothly. And we have been fortunate, with few exceptions, in selecting as chairman a man high in the esteem of the manufacturers, a man of character, of experience in handling large undertakings and enterprises, and perhaps the most important feature, a man high in the esteem and respect of railway officers. Our reason for attending and exhibiting our products at the conventions is purely a business one. The railway men are there for business. It therefore behooves us to select as officers men who have the esteem of railway officers; who can and will conduct the business affairs in connection with our association in such a manner as to promote harmony, not only among ourselves, but chiefly with the railway people; broad, liberal minded men, who are high in the courts of their own companies, who will accept the offices not for the honor which accrues, or in order to please their friends and grind axes by favored appointments, but in order to keep the standards of the association on a broad, high level.

We, as an organization, want to merit the respect of railway officers; we want them to welcome the supply men's annual coming together and their efforts to show, by the exhibits, the progress made during the intervening year; we want them to feel that our officers are distinguished men; distinguished for being representative of the class of men who call at their offices from time to time in the endeavor to promote the sale of their manufactured products; distinguished in ability, technical training, tactfulness, character and high standing in the communities where they live and in the councils of their respective concerns.

The foregoing was one of the ideas which led some of the representative manufacturers to suggest the permanent organization, with constitution and by-laws.

As an example of what can be accomplished with efficient and representative men at the head of an organization, review in your own minds, the work of the Railway Business Association. Could the work have been accomplished with an inferior quality of material, a second rate class of men?

The future of our organization depends upon the officers we select this year. Shall the railway men continue to feel that our presence is welcome at the conventions, or shall we be subjected to the humiliation of being notified to the contrary. Perhaps we may feel that matters are moving along so smoothly that the above remark is superfluous; and if so, we are greatly mistaken. It rests with the individual members of our association whether we stand or fall. Let me tell you that no representative and high class, eligible man is as yet in the field as a candidate for president of the association for the coming year. There are practically only two men of the desired type available for the position. They are men who stand high in the esteem of railway officers and manufacturers; they are chief executives in their own respective companies; they are men whom we point to as successful; they are men of character, refinement, education and tact, and should look at the position not only as an honor, but as a duty. The chairman or president of our association has, in the majority of cases, come from the East. The West, or Middle West, should have the honor this year.

We cannot afford to allow our likes or dislikes of individuals to influence us in the selection of officers this year (or any year, in fact). Because a man is your friend does not, of itself, fit him for chief executive of an organization; he must have other qualities. Let every supply man consider these matters seriously. Then show serious interest by attending his district meeting and the general meeting and securing the best men in the Railway Supply Manufacturing business as officers for the ensuing year.

A RAILWAY SUPPLY MAN.

BANK VERSUS LEVEL FIRING.*

BY E. D. NELSON,
Engineer of Tests, Pennsylvania R. R.

Methods of firing coal have been discussed almost since the time that coal came into use as a locomotive fuel. The question of the best method to be used on the locomotive testing plant has always been an important one. It must not only be, as far as possible, the most economical method, but also one that can be followed uniformly and capable of reproduction by different men, for the reason that it is not possible to always have the same men firing the locomotive. The personal equation in firing on the testing plant is one that must be reduced to the minimum. It has been the practice since the plant has been in operation to use a level fire and at all times to carry as light a fire as possible, considering the kind of coal and the amount which must be burned per square foot of grate. This method of level firing can be consistently followed and the man in charge of plant can at any time satisfy himself that the firing is being done by this method. It would be much more difficult to keep conditions constant with a less simple method.

The method of level firing has also been followed largely on the road, and instructions covering methods of firing have described this as the most economical method. The advantages of bank firing were brought forward in the summer of 1908 and tests were undertaken to settle generally and definitely the advantages of this latter method over the level firing method. There were decided differences of opinion on the road as to which method was the better in order to secure freedom from smoke and economy in the use of fuel. To settle this question, the work was undertaken on the locomotive testing plant where uniform conditions and accurate measurements can be taken.

The method referred to as bank firing consists in building up, at the back end of the fire, a bank or ridge of fuel, just inside of the fire door. This ridge of fuel when built up to its full height has its top at about the level of the top of the fire door. Coal is fired over the top of this bank and slides down the incline toward the front of the fire box, being assisted by the slope of the grate. Coal is distributed along the ridge or bank and finds its way down to the level portion of the fire at the front end of the grate.

The claims of superiority for this method over the level

*A paper presented at the annual convention of the American Railway Master Mechanics' Association.

firing are—the fuel, heaped up at the back of the firebox, is coked, the hydrocarbons are driven off slowly and, traversing the whole length of the firebox, are burned with little smoke; the bank of green coal, extending up over the door opening, protects the fireman from part of the heat that is radiated from the fire; the work of placing the fuel is simplified, the coal being fed to the top of the bank instead of being distributed over the grate.

The locomotive used for these tests was the Pennsylvania Railroad standard class H6b locomotive, consolidation type, having a total heating surface of 2,505 square feet based on the fire side of the tubes. This is the basis upon which all calculations rererring to heating surface are based. The heating surface of the water side of the tubes and the fire side of the firebox, which is usually taken as representing the heating surface of the locomotive, is approximately 2,840 square feet. The grate area of this locomotive is 48.66 square feet, so that the ratio of heating surface to grate surface is 51.49. The steam pressure was 205 pounds.

One series of tests was conducted running the locomotive at about 13½ miles per hour, with a cut-off of forty per cent. This gave a drawbar pull of about 22,000 pounds and a drawbar horse-power of about 800. Another series of tests was then run at about 16½ miles per hour with a cut-off of forty-five per cent., giving a drawbar pull of approximately 23,400 pounds, with a drawbar horse-power of 1,030.

The running conditions for these series were selected largely because the conditions stated required approximately eleven pounds of steam from and at 212 deg. F. for each square foot of heating surface for the first series, and about fifteen pounds for the second series. Road conditions fall generally between these limits. Furthermore, it was arranged that part of each series was run with one kind of coal and part with another. We therefore obtained comparisons with two grades of fuel and two rates of evaporation for both the bank firing and the level firing.

The selection of firemen for this work was not difficult. They were two men who were strong advocates of bank firing and three who believed in level firing. These men were all from the same section of road and the coal hereafter designated as No. 2 is what they were accustomed to using. In addition there were the two regular testing plant firemen and one other fireman from a different section of the road. For the purpose of reference on tables and in the text, these will be designated as follows:

B2—Advocate of bank firing.
B2— " " bank "
L1— " " level "
L2— " " level "
L3—Advocate of level firing.
T1—Testing plant fireman.
T2—Testing plant fireman.
R —Road fireman.

COAL.

The approximate analysis of the coals used is as follows:

	No. 1.	No. 2.
Fixed carbon	60.10	48.17
Volatile combustible	30.36	36.37
Moisture	.74	2.04
Ash	8.80	13.42
	100.00	100.00
Sulphur	2.08	3.18

The methods used in firing the level fire were very much the same in the case of each of the men advocating level fire. The coal was broken rather fine, to two inches in thickness or less, and was fired in single shovelfuls or at a uniform rate.

The bank fire firemen did not follow strictly the method of firing the bank fire as given above. A bank was built up, but with the exception of test No. 1278, the bank served only as a protection from the heat and glare of the fire, the coal being fired in small quantities and uniformly over the entire grate, except over the bank. The bank top was about eighteen inches inside of the fire door, and with the bank so short on a practically level grate, it is evident that the coal would not slide by gravity to the front of the firebox. In test No. 1278 an attempt was made to fire by placing all of the coal on the top of the bank. The bank in this case extended about 3½ feet inside of the fire door and the fire at the front of the firebox was very thin.

In tests 1277 and 1278, bank fire tests, the same fireman fired throughout the test, but in the other bank-fire tests the fire was prepared by the testing-plant fireman and then turned over to the bank-fire fireman to build up the bank and continue firing to the end of the test. In these later bank-fire tests the bank was allowed to burn out just before the end of the test and the fire had been restored to its first condition at the end of the test. The bank would be burned out in less than seven minutes. All of the firing, both level and bank, was continuous, small quantities being fired at one time and the coal was broken down before firing.

On Tables 1 and 2 a summary of the results of the tests are given. The tests on Table No. 1 were run at a speed equivalent to about 13½ miles per hour and a cut-off of forty per cent., giving an evaporation of eleven pounds of water per square foot of heating surface per hour. The tests in Table No. 2 were run at a higher speed, namely, 16½ miles per hour and forty-five per cent. cut-off, giving an evaporation of fifteen pounds of water per square foot of heating surface per hour.

In column 4 of the tables a comparison is made between the

TABLE 1.—*Evaporation and Smoke—No. 1 Coal.*

Test No.	Fireman.	R. p. m.	Cut-off.	Throttle.	Boiler press., average.	Per sq. ft. htg. surf., pr hr.*	Per lb. of dry coal.*	Relative efficiency; best evap. = 100 per cent.	Carbon monoxide in gases, av., per cent.	Kind of fire.	Smoke No., av.
					1.	2.	3.	4.	5.	6.	7.
1276	L1	80	40	F.	197.4	10.84	8.33	91.8	0.35	Level.	1.4
1275	T1	80	40	F.	201.6	11.36	9.07	100.0	0.60	Level.	1.8
Average								95.9			
1277	B1	80	40	F.	202.0	11.07	9.04	99.7	0.95	Bank.	1.4
Average								99.7			
					No. 2 Coal.						
1285	L3	80	40	F.	202.3	10.88	8.68	91.9	0.10	Level.	1.2
1288	T1	80	40	F.	201.0	10.86	9.17	97.0	....	Level.	1.6
1284	L1	80	40	F.	203.3	11.08	9.18	97.1	....	Level.	1.4
Average								95.3			
1286	B2	80	40	F.	203.3	11.09	8.66	91.6	0.35	Bank.	1.4
1287	B1	80	40	F.	202.9	11.04	9.45	100.0	0.10	Bank.	1.2
Average								95.8			

*Equivalent evaporation from and at 212 deg. F.

TABLE 2.—*Evaporation and Smoke—No. 2 Coal.*

Test No.	Fireman.	R. p. m.	Cut-off.	Throttle.	Boiler pressure average.	Per sq. ft. htg. surf., pr hr.*	Per lb. of dry coal.*	Relative efficiency; best evap. = 100 per cent.	Carbon monoxide, in gases, average.	Kind of Fire.	Smoke No. avg.
					1.	2	3.	4.	5.	6.	7.
1279	L2	100	45	F.	197.7	14.89	7.35	83.2	1.05	Level.	2.4
1283	R	100	45	F.	199.7	14.85	7.72	87.4	1.30	"	2.1
1289	L1	100	45	F.	200.3	14.59	8.07	91.4	0.15	"	1.5
1290	L3	100	45	F.	198.4	14.59	8.14	92.2	0.35	"	1.9
1293	T1	100	45	F.	197.3	14.29	8.53	96.6	0.80	"	1.7
1281	T2	100	45	F.	202.0	15.07	8.57	97.1	0.45	"	2.0
Average								†91.3			
1278	B2	100	45	F.	193.5	14.31	6.89	78.0	0.30	Bank.	2.6
1292	B2	100	45	F.	198.7	14.66	7.82	88.6	0.85	"	2.1
1282	B2	100	45	F.	200.5	14.88	7.99	90.5	0.70	"	2.3
1280	B1	100	45	F.	201.8	15.07	8.16	92.4	0.45	"	2.5
1291	B1	100	45	F.	200.5	14.51	8.83	100.0	0.0	"	1.4
Average								89.9			
Average								‡92.8			

*Equivalent evaporation from and at 212 deg. F.
†3½-ft. bank. The other tests are with an 18-in. bank.
‡Omitting test No. 1278.

evaporation obtained by the different firemen. The highest evaporation for each group of tests is taken as 100 per cent.

Considerable differences are shown between the level-fire firemen. It is very clear, too, that the second test made by some of the men shows a very decided improvement over the first trial on the testing plant.

In the case of fireman "B2" with a bank fire, in test No. 1278, an evaporation of 6.89 pounds is shown, while on the next test, No. 1282, made by the same fireman, an evaporation of 7.99 pounds was obtained, an increase of about fourteen per cent. and a saving of 961 pounds of coal in the second test. This would be a saving of about 2,800 pounds over a 100-mile division.

At a point near the fire door a thermometer was suspended and observations of the temperature were made for each kind of firing, with the following results:

In test No. 1283, level fire, the temperature was 117 deg. F.
In test No. 1281, level fire, the temperature was 114 deg. F.
In test No. 1282, bank fire, the temperature was 104 deg. F.
In test No. 1280, bank fire, the temperature was 94 deg. F.

In the tests at 100 revolutions per minute the range of coal fired per square foot of grate is from 85 to over 105 pounds. The best results, or highest evaporation per pound of coal, are for the bank fire as fired by fireman "B1." These tests are 1287 and 1291, and it will be noted that they were the last tests fired by this fireman, showing that this fireman improved in his firing by experience at the plant. Firemen "T1" and "T2" had had considerable experience at the plant, firing between them seventy-five tests, and the results of their tests with the level fire are very close together. At 100 revolutions per minute, the difference in the evaporation per pound of

coal between the tests 1281 and 1293, by these two firemen, is but four-hundredths of a pound. At eighty revolutions per minute, fireman "T1" duplicates his two tests, 1275 and 1288, within one-tenth of a pound.

Observations of the smoke by the Ringlemann method were made at 10-minute intervals during each test, and the results are conflicting (See Tables 1 and 2). With No. 1 coal at eighty revolutions per minute the level fire shows the most smoke. At eighty revolutions per minute and No. 2 coal the level fire again shows the most smoke. At 100 revolutions per minute and with No. 2 coal the bank fires show the most smoke.

The amount of carbon monoxide (CO) in the smoke-box gases is dependent upon the completeness of the combustion, a large amount of CO indicating poor air supply and consequent incomplete combustion.

An inspection of the smoke-box gas anlayses does not show any marked difference between the two methods of firing. The least quantity of CO was obtained in bank-fire test 1291.

The intensity of the draft at any speed and cut-off depends upon the thickness of the fire, and as the draft does not seem to have been affected by the method of firing, we may assume that the average thickness was the same in both the level and bank firing. The reason for the draft not being greater in test No. 1278, where a thick fire was carried at the back end, is that the fire was very thin in front and most of the air supply for the fire came through that portion of the grate.

Of the two methods of firing, the results for the bank firing as practiced at the locomotive testing plant during these tests, show a slightly higher evaporation of water per pound of coal. This is based on the results of the level firing and the bank firing where a short bank was used. The large bank will be referred to later. The result in favor of the bank firing is due, possibly, more to the skill of the fireman than to the methods used. It would, therefore, seem safe to conclude that the amount of coal used with the low bank fire and with the level fire are the same.

If, however, the method of firing as practiced by fireman "B2" in test No. 1278 is followed, the results are much less satisfactory than with the level fire. As the bank firing employed in test No. 1278 was used in the first test with No. 2 coal, to which the advocates of bank fire were accustomed, it would appear that the size of the bank, in this test, and the method of firing it were that which had been claimed to be more economical than the level fire. This method of bank firing is undoubtedly proved to be far from economical as compared with level firing, and the fact that fireman "B2," who formerly advocated this method of firing, changed to the small form of bank after seeing the results, seems to be corroborative evidence that the large bank, as first tried, was, in his estimation, not to be compared in economy with level firing.

It should be emphasized particularly that in speaking of bank firing as a method, the size of the bank which is to be employed must be clearly understood. The general statement that bank firing and level firing can be placed on a par, so far as economy in fuel is concerned, is misleading, unless a description of the bank method of firing is given.

The idea of the larger bank seems to be that it forms some protection for the fireman against the heat from the firebox and permits the firing to be done largely at the back end of the firebox, the coal or partly consumed coal working its way forward. It is this method of bank firing which has been shown to be uneconomical.

The method of bank firing with the low bank does not require all the coal to be fired at the back end, but requires firing in much the same way as with the level fire. The temperature from this form of bank has been shown to be from 10 to 23 deg. F. less near the fire door than with the level fire.

The officially licensed baggage porters of Berlin, of whom at the time there are 373, have made a combination with a local baggage express for the carriage of baggage from stations to domicile and from domicile to stations, due notice being given, and have the exclusive privilege for this service. The new organization promises to deliver baggage within three hours from all trains arriving between 7 a.m. and 7 p.m., and from night trains by 10 a.m. the next morning, and printed forms may be obtained on arriving trains for such delivery; that is, a baggage express service on American lines is established. The prevailing habit of taking baggage with cabs has heretofore been thought to prevent the success of such an enterprise; but the complete street railway system makes the population more independent of cabs.

LOCOMOTIVE PERFORMANCE UNDER SATURATED AND SUPERHEATED STEAM.*

BY W. F. M. GOSS,
Dean of the College of Engineering, University of Illinois.

Under the patronage of the Carnegie Institution of Washington, there have been completed, at the laboratory of Purdue University, two elaborate series of locomotive tests. The first had for its purpose the determination of the performance of a locomotive using saturated steam; the second, that of a locomotive using superheated steam. A description of the methods and results of the first series has been published by the Carnegie Institution** and a similar description of the second series is now in preparation for publication.† The facts presented herewith are drawn from the more elaborate presentation of these two sources.

The locomotive upon which the tests were made is that regularly employed in the laboratory of Purdue University. As used in the tests involving saturated steam, it was known as Schenectady No. 2, and since its reconstruction with a superheater, it has been known as Schenectady No. 3. It was originally ordered of the Schenectady Locomotive Works in 1897. The boiler is substantially of the same capacity as that of its predecessor in the laboratory, and which in later years has been referred to as Schenectady No. 1. Schenectady No. 2, which was employed in these experiments, was designed to operate under pressures as high as 250 pounds. When converted into Schenectady No. 3, no changes were made in the machinery, but the tubing of the boiler was entirely reconstructed. The superheater was made and installed by the American Locomotive Works at Schenectady, and is of the Cole type.‡

The tests with superheated steam were run at four different pressures, namely, 240, 200, 160 and 120 pounds respectively, a range sufficient to afford an excellent comparison with results obtained by the use of saturated steam. The tests at 160 pounds pressure are sufficiently numerous to define the performance of the locomotive when operating under all conditions of speed and cut-off which can be maintained with a wide-open throttle. Tests at the other pressures involve the more usual positions of reverse lever and three different speeds.

These tests were made between November, 1906, and August, 1907, during which period the locomotive made 1,417,995 revolutions, equivalent to 4,841 miles.

The standard fuel for these tests was Youghiogheny lump, an average analysis of which is as follows:

Moisture	1.89
Volatile matter	31.94
Fixed carbon	57.71
Ash	8.46
Heating value per lb. of dry coal (B. t. u.)	14,047
Heating value per lb. of combustible (B. t. u.)	15,372

The pounds of water evaporated from and at 212° F. per pound of dry coal, plotted with the rate of evaporation (equivalent pounds of water from and at 212° F. per square foot of heating surface in the boiler and superheater) is shown in Fig. 1. The single point shown on each line is the average for all tests at the pressure indicated. The equations representing performance as established by these lines are:

Boiler pressure.	Equation
240 lbs.	$E = 11.532 - 214\ H$
200 "	$E = 11.612 - 214\ H$
160 "	$E = 11.568 - 214\ H$
120 "	$E = 11.928 - 214\ H$

Where E is the number of pounds of water evaporated from and at 212° F. per pound of dry coal, and H is the number of pounds of water evaporated per square foot of water and superheating surface per hour. The area of the heating surface employed is based upon the interior surface of the firebox and the exterior surface of the boiler and super-heater tubes.

It will be seen by reference to Fig. 1, or to the equations given, that the highest efficiency is obtained in connection with the lowest boiler pressure, and conversely that the lowest efficiency is obtained in connection with the highest boiler pressure. These results are in agreement with those obtained from locomotive Schenectady No. 2, using saturated steam. The explanation is not entirely apparent, though for some reason it appears easier to maintain a satisfactory condition of fire when the operation is under low pressure. In general, longer cut-offs were employed in

*Abstract of a paper presented at the annual convention of the American Railway Master Mechanics' Association.

**"High Steam Pressure in Locomotive Service," published by the Carnegie Institution, Washington, D. C.

†"Superheated Steam in Locomotive Service," the Carnegie Institution, Washington, D. C.

‡For a detailed description of this superheater, see "Notes Concerning the Performance of a Cole Locomotive Superheater," Vol. 28, *Proceedings* of the American Society of Mechanical Engineers.

connection with the lower pressures and the resulting difference in draft action may constitute the chief cause.

As noted in connection with the tests under saturated steam, differences due to changes in pressure are not great and for the purpose of defining the performance of the boiler in simple terms, they may be neglected. Such a definition is supplied by Fig. 2, which is made up by plotting results from all 240-pound tests, six in number, together with six representative tests from each of the other series, by averaging the points in two groups and by drawing a straight line through the points thus obtained. The equation for this line is,

$$E = 11.706 - 214\ H,$$

where E is the equivalent evaporation from and at 212° F. per pound of dry coal for boiler and superheater and H is the

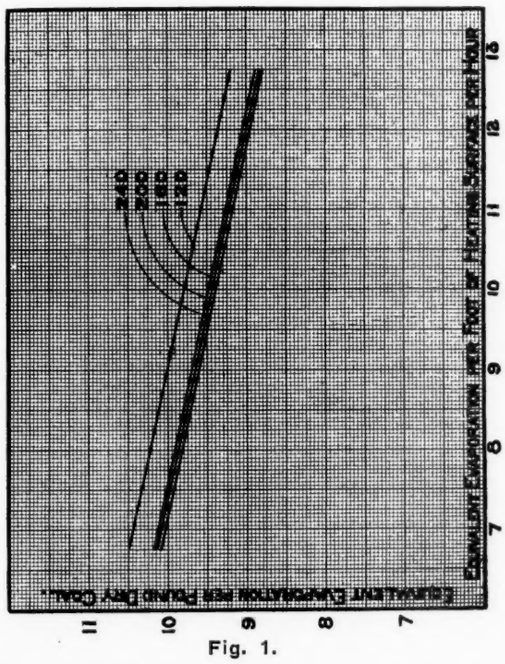


Fig. 1.

equivalent evaporation per square foot of water and superheating surface. It is proposed to accept this equation as representing the performance of the combined boiler and superheater.

The pounds of water evaporated in the boiler from and at 212° F., exclusive of the superheater, per pound of coal, plotted against equivalent pounds of water evaporated per square foot of water heating surface in the boiler, is shown in Fig. 3. The equation for the average line is,

$$E = 11.105 - 2.087\ H.$$

This equation takes into account only that work done by the boiler.

The temperature of the superheated steam was measured by

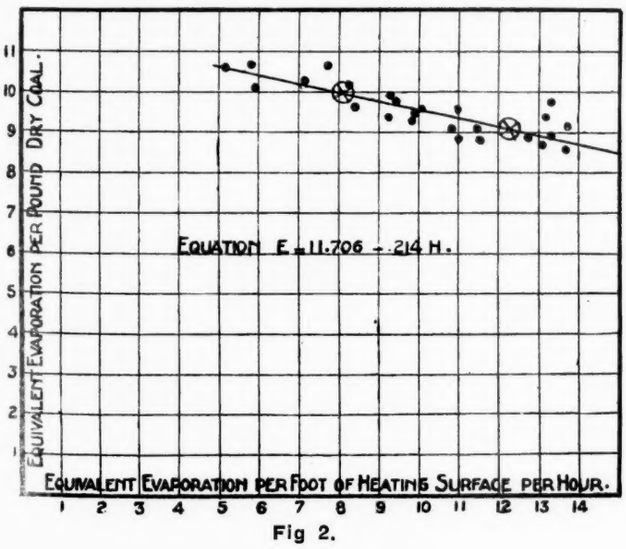

EQUIVALENT EVAPORATION PER POUND DRY COAL.
EQUATION E = 11.706 - .214 H.
EQUIVALENT EVAPORATION PER FOOT OF HEATING SURFACE PER HOUR.
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Fig 2.

high grade mercurial thermometers placed in the branch pipes at a point directly adjoining the connection to the superheater headers. The degree of superheat thus determined increases as the rate of evaporation increases and diminishes as the boiler pressure is increased. Equations derived from diagrams showing this relationship, which represent the experimental results with a high degree of accuracy, are as follows:

Boiler pressure.	Equation
240 lbs.	T = 54.4 + 7.28 H
200 "	T = 74.2 + 7.28 H
160 "	T = 85.0 + 7.28 H
120 "	T = 87.1 + 7.28 H

Where T equals the degrees superheat and H equals the equivalent pounds of water from and at 212° F. per square foot of water heating surface per hour. Assuming a constant rate of evaporation for the several boiler pressures, as, for example, 11 pounds, it appears that the amount of superheating increases when the boiler pressure is reduced, as follows:

When the pressure is 240 lbs., the degree of superheat is 135.
" " " " 200 " " " " " " 154.
" " " " 160 " " " " " " 165.
" " " " 10 " " " " " " 170.

These values are shown graphically in Fig. 4. While the

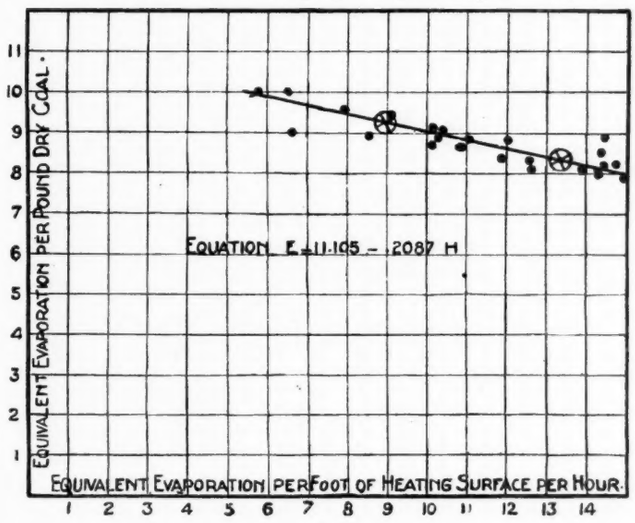

EQUIVALENT EVAPORATION PER POUND DRY COAL.
EQUATION E = 11.105 - 2087 H
EQUIVALENT EVAPORATION PER FOOT OF HEATING SURFACE PER HOUR.
1 2 3 4 5 6 7 8 9 10 11 12 13 14

Fig. 3.

mean line of Fig. 4 is a curve, a straight line can be made to represent the points without introducing an error greater than 2 per cent. Employing such a line as a basis, the degree of superheat for any pressure may be expressed as follows:

$$T = 123 - .265\ P + 7.28\ H,$$

where T equals the degrees superheat, P the boiler pressure by gage, and H the equivalent evaporation per square foot of water-heating surface in the boiler.

The ratio of the heat absorbed per square foot of superheating surface to that absorbed per square foot of water-heating surface expresses the relative efficiency of the water and of the superheater surface. This ratio increases in value as the rate of evaporation increases. Thus, when the boiler pressure is 160 pounds, it has a value of 34 per cent. when the rate of evaporation is 6, and 53 per cent. when the rate of

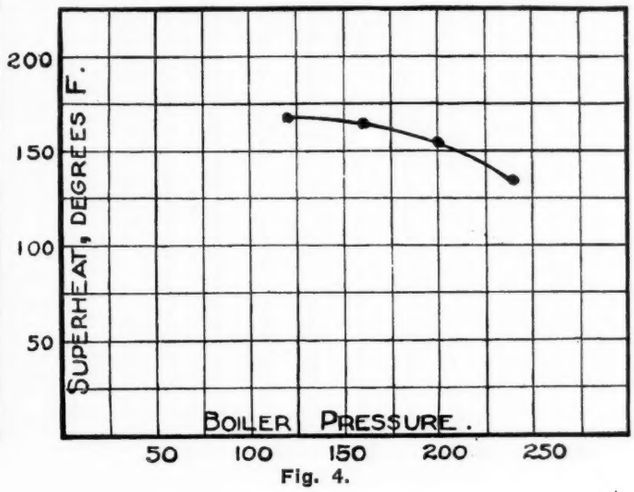


Fig. 4.

evaporation is 14. Expressing the rate of heat absorption as pounds of water evaporated from and at 212° F. per square foot of water-heating surface, the relation is well shown by Fig. 5. The data show that at all other boiler pressures employed, the value of the ratio varies in exactly the same way, which is equivalent to the statement that the ratio is independent of boiler pressure.

The temperature of the smokebox gases was read by a mercurial thermometer placed midway between the diaphragm and the front tube sheet. The results show, as would be expected, that the temperature increases with the rate of evapo-

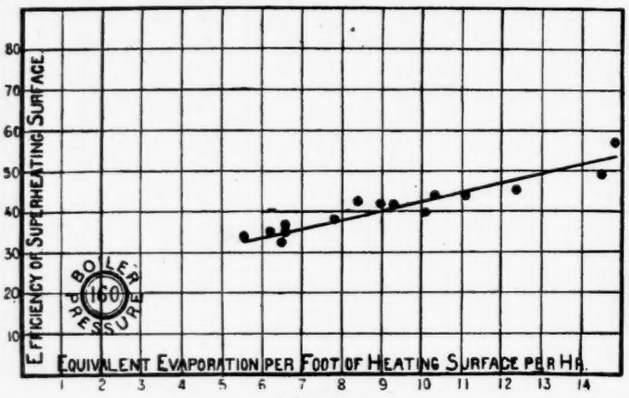


Fig. 5.

ration as in the case of those obtained in connection with saturated steam. Equations representing the exact relationship and which were obtained by drawing an average line through the actual points plotted against rate of evaporation are as follows:

Smokebox Temperatures under Different Boiler Pressures.

Boiler pressure.	Equation
240 lbs.	$T = 468.1 + 26\ H$
200 "	$T = 482.6 + 26\ H$
160 "	$T = 464.6 + 26\ H$
120 "	$T = 446.1 + 26\ H$
Average	$T = 465.35 + 26\ H$

The values indicated by these equations are somewhat less than those established by the tests with saturated steam.

The draft produced in the front end of the locomotive was measured at a single point, namely, directly in front of the diaphragm. Results for the group of tests at 120 pounds plotted with the rate of evaporation (equivalent evaporation from and at 212° F. per square foot of heating surface in the boiler and superheater) are shown by Fig. 6. Similar curves representing tests at other pressures all agree in showing values which are somewhat lower than those involved by the

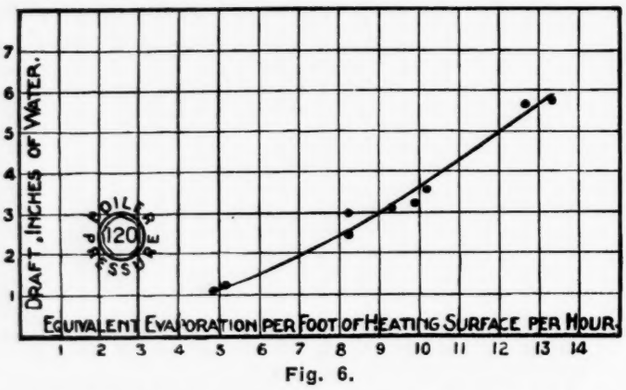


Fig. 6.

tests under saturated steam (locomotive Schenectady No. 2). If, however, draft values for the two locomotives are plotted in terms of the total output of equivalent steam, the results are identical.

The failure of previous efforts to secure data which would serve in the assignment of definite reasons for the irregularities shown in the evaporative efficiency of locomotive boilers, made it desirable to undertake on a more elaborate scale than ever before a chemical analysis of the fuel used and of the smokebox gases, the cinders and of the refuse caught in the ash pan for each test. As a result of these precautions and of the extreme care taken with all other portions of the work it is now possible to present a satisfactory heat balance of the boiler under conditions prevailing during eighteen tests. These are presented graphically by Fig. 7.

In this diagram the term "heating surface," as employed in designating the terms of the abscissæ, includes the heat transmitting surface of both boiler and superheater. The ordinates of the diagrams represent the per cent. of heat in the fuel supplied. Distances measured on ordinates between the axis and the first broken line, A, represent the percentage of the total heat supplied which is absorbed by the water of the boiler. The line A is, in fact, a definition of the efficiency of the boiler under the varying rates of evaporation represented by

FIG. 23.—Draft.

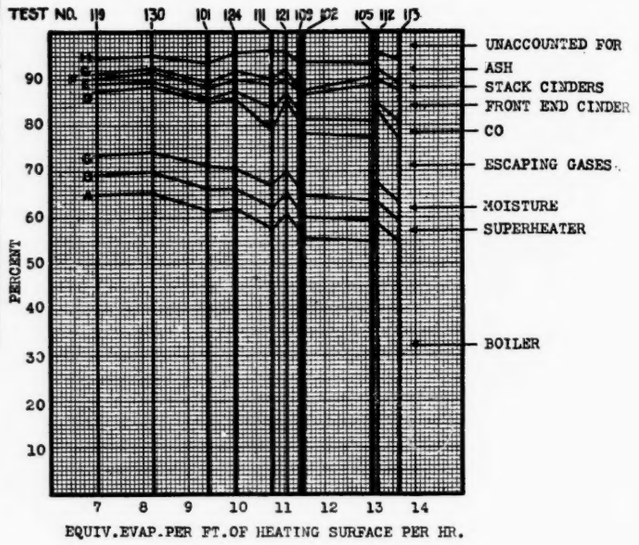


Fig. 7.

the series of tests. While based upon a different unit, it is, as it ought to be, similar in general form to the lines defining the evaporative efficiency of the boiler in terms of pounds of water evaporated per pound of coal used. The inclination of all such lines show the extent to which the efficiency of the boiler suffers as the rate of evaporation is increased. The nature and extent of the losses leading to such a result are to be found in the areas above the line A. The fact that the points representing different tests through which this line A is drawn do not result in a smooth curve is due to irregularities in furnace conditions which were beyond the vigilance of the operator, an explanation which applies equally to other lines, B. C. D, etc., of the same diagram. Again, where the points upon which the line A is based fail to line in a smooth

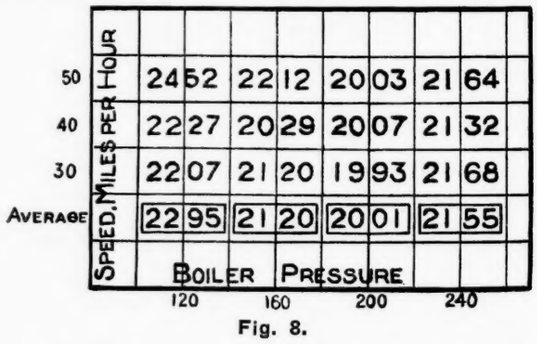


Fig. 8.

curve, the reason therefor is to be found in the location of the lines above.

The percentage of the total heat which is absorbed by the superheater is measured by distances on ordinates between tne line A and the line B. It is apparent that this quantity is practically constant, whatever may be the power, to which the boiler is driven; that is, the superheater in question is a device of constant efficiency. The normal maximum power of a locomotive may for present purposes be taken as that power which is represented by an evaporation of 12 lbs. of water per foot of heating surface per hour. Basing a statement on results obtained at that rate of power, the superheater, which contains 16 per cent. of the total heat-transmitting surface, receives approximately 8 per cent. of the total heat absorbed. Distances between the broken line B and the axis represent

the efficiency of the combined boiler and superheater, while distances above the line B serve to account for the various heat losses incident to the operation of the furnace, boiler and superheater.

Losses of heat arising from the presence of accidental and combined moisture in the fuel, the presence of moisture in the atmospheric air admitted to the firebox and of moisture resulting from the burning of hydrogen in the coal are represented by distances measured on ordinates between the lines B and C. It is of passing interest to note that the heat thus accounted for is practically equal to that absorbed by the superheater.

Losses of heat in gases discharged from the stack are represented by distances measured on ordinates between lines C and E. The distances between the lines D and E represent that portion of these losses which is due to the incomplete burning of the combustible gases. The record shows that the stack loss (CE), while necessarily large, increases with increased rates of combustion far less than has been commonly supposed. In other words, the loss in evaporative efficiency with increase of power (Fig. 2, also line B, Fig. 7) occurs only to a very slight degree through heat carried away with the smokebox gases. That portion of this loss which is chargeable to incomplete combustion (CO) is small under low rates of combustion, but may increase to values of some significance under the influence of very high rates of combustion, as will be seen from the records of the coal B. This is well shown by a comparison of the two diagrams.

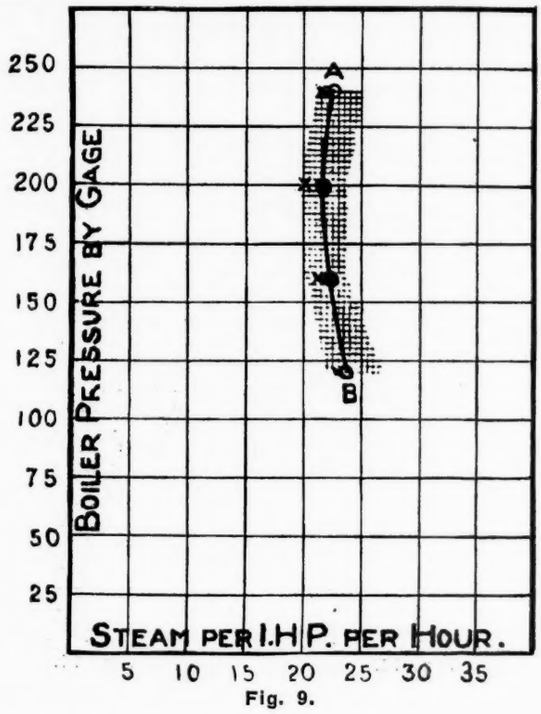


Fig. 9.

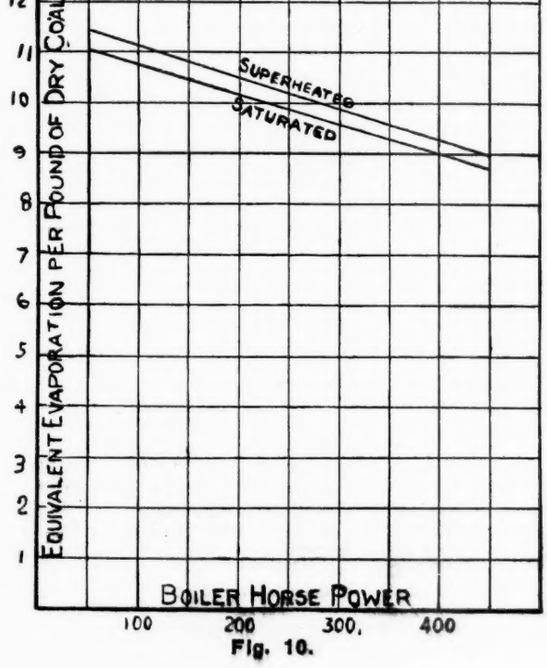


Fig. 10.

Radiation, leakage and all losses not previously accounted for are represented by distance ordinates between the line H and the 100 per cent. line of the diagram. The radiation losses are probably not much in excess of 1 per cent., so that the remainder of this loss, which equals from 3 to 8 per cent. of the total heat available, represents sparks from stack too small to be caught, leakage of steam or water, or inaccuracy in the determination of quantities already discussed.

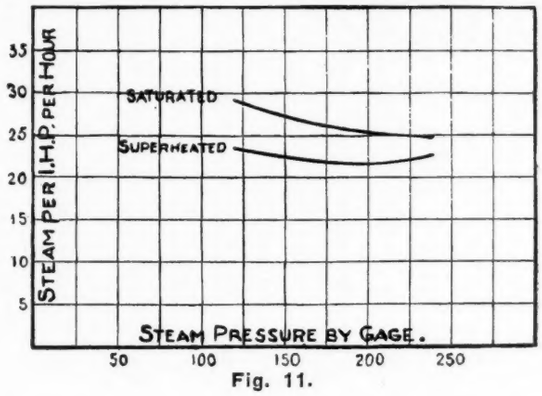


Fig. 11.

The tests made with superheated steam, except in the case of those at 160 lbs., do not cover the entire range for which it was practicable to operate the engine under a fully open throttle; hence, values obtained do not necessarily include the maximum power which it is possible to develop. The greatest power actually indicated approaches 600 horse. The effect of changing the boiler pressure upon the power output of the engine at constant speed for any given position of the reverse lever was well shown by the data. Thus, at a speed of 30 miles per hour, and with the reverse lever in the second notch from the center forward, 160 lbs. boiler pressure gave 196 h.p.; 200 lbs. pressure, 280 h.p., and 240 lbs. pressure 370 h.p.

Since tests representing the entire range of performance of the locomotive were run for only one pressure, 160 lbs., the variation of steam consumption from its maximum to its

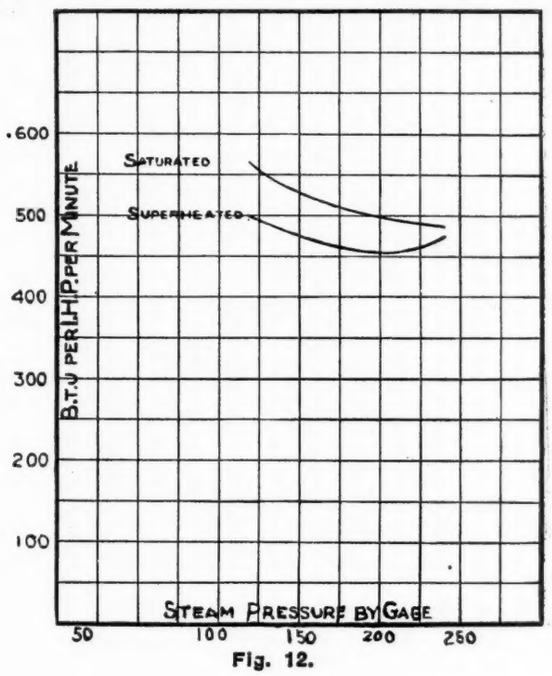


Fig. 12.

minimum value will be found only in the results of this series. Thus, at this pressure for a speed of 50 miles per hour and the reverse lever in the second notch from center forward, the actual steam consumption is 26.06 lbs. per indicated horse-power per hour, which is the maximum value recorded. A minimum value of 20.29 is to be found when the speed is 40 miles per hour and the position of the reverse lever is eight notches from the center forward. If, however, these extreme values are omitted, the steam consumption for the remaining conditions of running varies but slightly.

The most efficient point of cut-off varies with the boiler pressure, and is, of course, greatest at the lower pressures. Thus, at 120 lbs. boiler pressure, the best cut-off is effected when the reverse lever is in the tenth notch, or 43 per cent.; at 160 lbs., the eighth notch, or about 35 per cent.; at 200 lbs., the sixth notch, or about 27 per cent., and at 240 lbs., the fourth notch, or about 21 per cent. The least steam consumption for each speed under the several different pressures is shown in Fig. 8.

The steam consumption in pounds per indicated horse-power per hour plotted with boiler pressure is presented graphically by Fig. 9. The shaded zone encloses an area within which the results of all tests fall. For purposes of comparison, however, it is desirable to define this performance by a single line. In reducing this zone to a representative line, the results of all second-notch tests at 160 lbs. pressure, which represent very low power and which are, therefore, abnormal, have been omitted, and in a few cases extrapolated values for other pressures have been inserted. The average of results thus set apart for the purpose is shown by the circles, Fig. 9. The line A B drawn through these circles is assumed as the representative line sought. The points indicated by crosses near the left-hand margin of the shaded zone represent the average of the minimum steam consumption for the several speeds under each different pressure, as set forth by Fig. 7.

The coal consumption as set forth in the numerical data represents values actually obtained. Values forming a more logical basis for comparison may be derived from equations expressing the performance of the boiler and superheater and the engine as already developed. Thus, the equation defining the performance of the boiler and superheater combined is,

$$H = 11.706 - .214\ H,$$

and that defining the performance of the superheater is,

$$T = 123 - .264\ P + 7.28\ H,$$

and that of the engine is defined by the curve A B shown in Fig. 9.

It is now proposed to determine the coal consumption per indicated horse-power per hour, assuming the efficiency of the locomotive to be that defined in the above relationship. Several steps in the process appear in order in the several columns of the table of locomotive performance under different pressures, the results sought being those of column 7.

From the values given in the table it will be seen that the coal consumption per indicated horse-power hour varies from 2.97 to 3.31. The minimum value, 2.97, is found at 200 lbs. boiler pressure.

In the chapters immediately preceding [in the pamphlet as printed.—ED.], an attempt has been made to establish in concise terms the performance of a locomotive using saturated steam and superheated steam. The two locomotives tested were identical, except with reference to those details of construction involved by the presence of the superheater. The machinery of the engine, including cylinders and valves, was the same, as was also the shell of the boiler, the firebox and the grate. The weight of the locomotive on its truck was probably greater in the case of the superheating locomotive, but the increase was very slight. Differences appear, however, in the number, size and arrangement of the flues and steam piping, and, as a consequence, in the extent of heating surface. Youghiogheny coal was the standard fuel. In the record of tests under saturated steam, results dependent on the fuel record are omitted when other coal was employed, and in the record of tests under superheated steam it has been possible to reduce results obtained with other coal to equivalent results which would have been obtained had the standard fuel been used.

Locomotive Performance Under Different Pressures.

Boiler pressure.	Pounds of steam per indicated horse-power hour. Values from curve.	B. T. U. per pound of steam. Feed 60 deg. F. and superheat from equation.	Equivalent pounds of steam per indicated horse-power hour.	B. T. U. per indicated horse-power per minute.	Equivalent pounds of steam per pound of dry coal.	Pounds of coal per indicated horse-power hour.
1	2.	3	4	5	6	7
240	22.6	1,258.7	29.45	474	9.426	3.12
220	21.8	1,261.8	28.48	459	9.501	3.00
200	21.6	1,263.1	28.25	455	9.518	2.97
180	21.9	1,261.7	28.61	461	9.491	3.01
160	22.3	1,259.3	29.07	468	9.455	3.08
140	22.9	1,256.4	29.79	481	9.399	3.17
120	23.8	1,252.7	30.87	497	9.316	3.31

The boiler of Schenectady No. 2, as designed to deliver saturated steam, gave an efficiency which is expressed by the equation,

$$E = 11.305 - .221\ H.$$

while the boiler of Schenectady No. 3, as equipped with a Cole superheater, gave an efficiency expressed by the equation,

$$E = 11.706 - .219\ H.$$

Obviously, on the basis of these equations, the superheating boiler has the advantage. The comparison is, however, not a fair one, since in both cases the equations are based on the extent of heat-transmitting surface, and this, in Schenectady No. 2, was greater than the combined water-heating and superheating surface of No. 3. To make the equation fair, the term in the equation representing equivalent pounds of water per square foot of heating surface (H) must be expressed in terms of the total power delivered by the boiler. Comparisons on this basis, showing the performance of the boiler in one case and of the boiler and superheater in the other case, expressed in terms of equivalent evaporation are shown diagrammatically by Fig. 10. It will be seen that even upon this basis the efficiency of the combined boiler and superheater is superior to that of the boiler alone, the increase averaging between 3 and 4 per cent. An examination of the related data, however, suggests that the lines of Fig. 10 should not be far apart. Thus, draft values plotted in terms of the rate of evaporation are less for the superheating locomotive than for the locomotive using superheater steam, but when these are plotted in terms of equal amounts of boiler power developed, they are identical for both locomotives, a condition which implies equality in the fuel lost in the form of cinders and sparks for

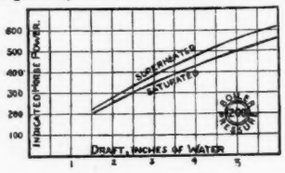


Fig. 13.

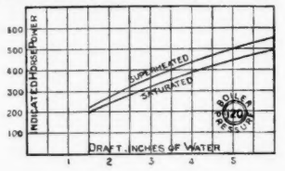


Fig. 14.

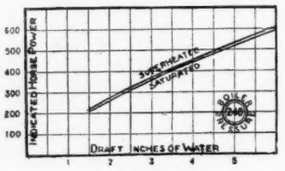


Fig. 15.

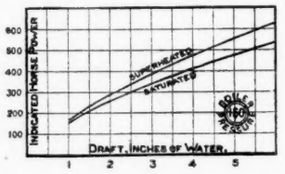


Fig. 16.

the two locomotives. Similar comparisons involving smoke-box temperature lead to identical conclusions. Upon the basis of these statements, the relation defined by Fig. 10 is not confirmed by collateral evidence, but this statement should not be accepted as discrediting the record, which is, in fact, of no small significance. The line of performance for the superheating locomotive (Fig. 10) depends upon the results of thirty-eight tests and that for the saturated steam locomotive upon the results of forty tests. It is, therefore, difficult to see how either could have been affected to the extent indicated by any incidental cause or causes. Whatever the conclusion may be with reference to this matter, it is clear that when both are worked at the same rate of power, the combined boiler and superheater of Schenectady No. 3 is not less efficient than the boiler of Schenectady No. 2, and, accepting the data at their face value, it shows that its efficiency is higher by approximately 4 per cent.

The steam consumption per indicated horse-power hour for the superheating locomotive, as determined by the results of thirty-eight tests, has been defined as the line A B, Fig. 9. Replotting the results presented by these figures upon a single sheet gives the diagram shown by Fig. 11. This exhibit, or perhaps better, the numerical values given in columns 2 and 4 of the table, showing steam per indicated horse-power hour, which follows, shows well the saving of water which is realized by the substitution of steam superheated approximately 150 deg. F. for steam which is saturated. The saving ranges from 18 per cent. when the boiler pressure is 120 lbs. to 9 per cent. when the boiler pressure is 240 lbs. It appears, also, that with superheated steam, the least consumption, 21.6, is secured when the boiler pressure is approximately 200 lbs., and that variations in the consumption resulting from changes in pressure are slight.

For example, the water consumption for all pressures between 160 lbs. and 220 lbs. falls between the limits of 21.6 lbs., the minimum value obtained, and 23.2 lbs., a range of approximately 4 per cent.

The saving of water in locomotive service is always a matter of moment. By reducing the time required to take water, the exactions of certain conditions in operation are diminished, and in some districts where water is bad or hard to obtain difficult problems either in locomotive maintenance or in the maintenance of the water supply are simplified. The fact, therefore, that superheating affords a material saving in the amount of water required is not to be overlooked in estimating the value of superheating as a practice. But the saving in heat is not proportional to the saving in water, for each pound of superheated steam represents a larger amount of heat than a pound of saturated steam at the same pressure. As an indication of the thermal advantage to be derived from the use of superheated steam in comparison with that of saturated steam, it is desirable to reduce the consumption in each case to the same thermal basis. This has been done with results which are shown numerically by the table below, and graphically by Fig. 12. From these exhibits it is evident that the saving effected by the use of superheated steam when the pressure is 120 lbs. is not less than 12 per cent., and when the pressure is 240 lbs. approximately 2 per cent. Under a boiler pressure of 180 lbs. the substitution of superheated steam for saturated steam improves the efficiency of the engine 9.1 per cent. The results show, also, that the performance of the superheating locomotive is affected by changes of pressure to a much smaller extent than that of the saturated steam locomotive.

Steam per Indicated Horse-power Hour.

Boiler pressure, lbs.	Saturated Steam — Pounds of steam per indicated horse-power per hour.	Saturated Steam — B. T. U. per indicated horse-power per minute.	Superheated Steam — Pounds of steam per indicated horse-power per hour.	Superheated Steam — B. T. U. per indicated horse-power per minute.
1	2	3	4	5
240	24.7	483	22.6	474
220	25.1	491	21.8	459
200	25.5	498	21.6	455
180	26.0	507	21.9	461
160	26.6	517	22.3	468
140	27.7	537	22.9	481
120	29.1	563	23.8	497

The performance of the locomotive as a whole, in terms of coal consumed per indicated horse-power hour, both for saturated steam and superheated steam, is shown numerically by the table below. They show that the gain resulting from the use of superheated steam is most pronounced at the lower pressures. Thus, at a pressure of 120 lbs. it is 17 per cent., while at a pressure of 240 lbs. it is but 6 per cent. They show, also, that the performance of the locomotive using superheated steam is only slightly affected by changes of pressure for the entire range of pressure between 120 lbs. and 240 lbs. With superheated steam the difference in coal consumption from minimum to maximum is but a third of 1 lb., while for pressures between 175 lbs. and 225 lbs. it is practically constant and always near the minimum. The least coal consumption per indicated horse-power hour as it appears in the summarized statement is 2.97. It was obtained under a steam pressure of 200 lbs. The results sustain a claim which has been put forward by advocates of the practice of superheating to the effect that the adoption of such practice permits a material reduction in steam pressure as compared with pressures now common in locomotive service without materially sacrificing efficiency. A detailed numerical statement showing the saving in coal resulting from a change from saturated to superheated steam is set forth in columns 4 to 7, inclusive, of the accompanying table:

Saving in Coal Effected by the Use of Superheated Steam.

Boiler pressure lbs.	Pounds of coal per Ind. h. p., per hr. — Saturatd steam.	Pounds of coal per Ind. h. p., per hr. — Suprhtd steam.	Saving effected by the use of superheated steam. — Over values obtained with saturated steam at same pressure. — Pounds, per Ind.h.p. per hr.	Saving effected by the use of superheated steam. — Over values obtained with saturated steam at same pressure. — Per cent.	Saving effected by the use of superheated steam. — Over values obtained with saturated steam at 180 lbs. press. — Pounds pr Ind.n.p. per hr.	Saving effected by the use of superheated steam. — Over values obtained with saturated steam at 180 lbs. press. — Per cent.
1	2	3	4	5	6	7
240	3.31	3.23	.19	5.72	.38	10.86
220	3.37	3.00	.37	10.98	.50	14.29
200	3.43	2.97	.46	13.31	.53	15.15
180	3.50	3.01	.49	14.00	.49	14.01
160	3.59	3.08	.51	14.21	.42	12.00
140	3.77	3.17	.60	15.98	.37	10.57
120	4.00	3.31	.69	17.25	.19	5.43

The maximum power presented by the data derived from the locomotive using superheated steam is not to be accepted as a measure of its capacity. Except in the case of the series of tests run at 160 lbs. pressure, the number of tests was insufficient to permit the establishment at each speed of a maximum cut-off for which the boiler could be made to supply steam. But while the direct evidence is lacking, the data contain much which goes to show that the superheating locomotive is a more powerful machine than the locomotive using saturated steam. For example, it has been shown that, for the development of equal amounts of power, the combined boiler and superheater of the superheating locomotive has an efficiency which, if it does not exceed, certainly equals that of the saturated steam locomotive. But each unit of power delivered from the boiler in the form of superheated steam is more effective in doing the work in the cylinder than a similar unit of power delivered in the form of saturated steam. Hence, at the limit, the superheating locomotive is the more powerful locomotive and the gain equals that which measures the difference in the economy with which the cylinders use steam. (Fig. 12.)

The same question may be dealt with through another series of facts as follows: It can be shown that the power of any locomotive is limited by its capacity to burn coal, and coal-burning capacity is a function of the draft. The data show that for the development of a given cylinder power, the draft values of Schenectady No. 3 (superheating) were in all cases less than those of Schenectady No. 2 (saturated). The extent of these differences is well shown by Figs. 13 to 16. These differences are of small value for tests under high pressure, but they increase as the pressure is reduced. For example, tests at 160 lbs. pressure (Fig. 15) show that the power developed in return for a given draft is from 10 to 16 per cent. greater for the superheating locomotive than for the locomotive using saturated steam. Obviously, there is no reason why the draft for the former should not be increased to limits practicable for the latter, and when this is done the power developed by the superheating locomotive would exceed that which is possible with the saturated steam locomotive by from 10 to 16 per cent.

In the preceding paragraphs an attempt has been made to define with accuracy the increased efficiency resulting from the substitution in locomotive service of steam superheated to approximately 150 deg. for steam which is saturated. The facts upon which comparisons have been based have been derived from carefully selected processes and the results can safely be accepted as the measure which has been sought. All discussion might well end with the presentation of these facts were it not that out of them arises a group of questions of great practical significance. To some of these attention may well be given.

As a general proposition, the gain which in any service will result from the introduction of a superheater is a function of the degree of superheat which is employed. The experience of the Prussian State Railway shows that superheaters may be designed and operated which deliver steam having a temperature of from 300 deg. to 350 deg. C. The latter value, however, is regarded as the maximum limit which must never be exceeded. Under normal conditions of running, however, the degree of superheat with a boiler pressure of 180 lbs. considerably exceeds 200 deg. F., which is not less than 33 per cent. in excess of the degree of superheat used in the experiments herein discussed. It has been shown, also, that the production and use of steam at this temperature introduce no difficulties either in the maintenance of the superheater nor in the parts of the machine which come under its influence. It is claimed that the advantage to be derived from the use of superheated steam increases more rapidly than the degree of superheat. But assuming the gain to be more than proportional to the degree of superheat employed, it is evident tnat the curves showing performance under superheating (Figs. 11 and 12) would be lower by 33 per cent. of the saving shown, had the temperature of the delivered steam in the locomotive experimented upon equaled that prevalent in German practice.

Upon this basis it can be shown that, under a boiler pressure of 180 lbs., there would be a reduction of water consumption from 26 lbs. to 20.5 lbs., a saving of 21 per cent., and a reduction of coal consumption per drawbar horse-power of from 4 lbs. to 3.25 lbs., a saving of 19 per cent. These values may be accepted as not far from those which should be accepted from tne adoption of superheating in locomotive service.

It will be a mistake, however, for one to assume that a railway company's bill for locomotive fuel may be diminished by the percentages set forth in the preceding paragraph, merely through the introduction of the superheater. It should be clear, for example, that no part of the fuel used in firing-up a locomotive in the roundhouse, nor of that consumed in maintaining the temperature of a locomotive between the roundhouse and the time of its starting at the head of its train can be saved by the application of a superheater. Again, fuel which is used in maintaining the normal temperature of all parts of the machine when the locomotive is at rest at stations and at passing points, in making good steam losses by safety valve and by leaky valves and pistons, or which comes through glands and cylinder cocks, must be regarded as fuel which cannot be saved through the presence of the superheater. Estimates based upon careful observations on several roads

have shown that the fuel used in these ways amounts to about 20 per cent. of the total fuel delivered to the locomotive. It appears, therefore, that the saving which is to be brought about by the adoption of the superheater is applicable to approximately 80 per cent. of the fuel which, under service conditions, is delivered to the tenders of locomotives using saturated steam.

The substitution of superheated for saturated steam under conditions where the power to be developed is fixed will permit:

1. The use of comparatively low steam pressures, a generally accepted limit being 160 lbs.
2. A saving of from 15 to 20 per cent. in the amount of water used.
3. A saving of from 10 to 15 per cent. in the amount of coal used while running, or of from 8 to 12 per cent. in the total fuel supplied.
4. Assuming the power developed to equal the maximum capacity of the locomotive in each case, the substitution of superheated for saturated steam will permit an increase of from 10 to 15 per cent. in the amount of power developed, accompanied by a reduction in total water consumption of not less than 5 per cent. and by no increase in the amount of fuel consumed.

MASTER MECHANICS' BALL.

The annual ball of the Master Mechanics' Association, which took place last night, was one of the most successful in the history of these events. The success was largely due to the careful preparations which had been made by the sub-committee of the entertainment committee, J. Will Johnson, chairman, assisted by Messrs. Oesterreich, Stayman, Mitchell, Knill, Younglove, Toothe and Walters. Mr. Johnson was in entire charge of the floor and the unusually definite and complete arrangements, especially for the grand march, were the result of his careful attention.

Twenty-two floor committeemen, members of the entertainment committee, had been assigned to separate stations and were in their places before the first note for the grand march was sounded. The arrangement of stations was a peculiarly noteworthy feature of the scheme. The stations had been so distributed that, with few exceptions, none of the committeemen was required to move from his first position. The exceptions were that one man was able to cover two stations in a few instances.

The line of march and its various evolutions is clearly shown, the start being at the south end of the ballroom and the finish opposite the entrance, the intermediate movements having included a double circuit of the hall, twice across the hall on diagonal lines from the corners to the middle of the opposite side, and once through the length of the hall in six parallel movements from side to side.

When President and Mrs. Vaughan entered the building they were greeted by the strains of "Hail to the Chief," and accompanied across the floor by a member of the entertainment committee to seats reserved for them in the booth of the Galena Signal Oil Company at the southwest corner of the building and opposite the starting point of the line of march. Charles P. Storrs, general chairman of the entertainment committee, acted as escort to the head of the column.

One of the especially attractive features of the evening occurred at the close of the march. As the marchers were formed into the last figure a beautiful ostrich feather fan was opened and presented to each of the ladies in line. The fans were in four colors, white, blue, pink and black.

After the smoke accompanying the taking of a flashlight photograph had cleared away, the floor was thrown open to dancers, who continued their devotions at the shrine of Terpsichore until the smaller hours of the morning. During the dancing the display of electric lights which constitutes one of the most attractive features of the ballroom on the pier was so manipulated as to indicate the character of the dance, colored lights indicating a waltz in progress and white lights a two-step.

MASTER MECHANICS' ASSOCIATION.

Proceedings of the Second Session of the Forty-second Annual Convention.

President Vaughan called the meeting to order at 9.35 o'clock and announced the first order of business to be the report of the Committee on Castle Nuts.

J. F. De Voy (C., M. & St. P.) presented the report.

The Secretary then read a communication from W. L. Austin, a member of the committee, saying he approved the report with the following exceptions:

(1) The nuts should be U. S. standard in thickness, not more.

(2) The thread should be turned off the outer end of the bolt, but the bolt should have a bearing of the full thickness of nut, in order to utilize all of the thread. (This incidentally avoids a little crevice in the nut for the accumulation of dirt.)

(3) There should be but one style of cotter, namely, the common cotter pin. If we use a solid taper pin we lose the lock nut feature, as such a pin is liable to jar out.

The following telegram from John Player, a member of the committee, was read:

"Report approved except following: Plate 3 A, 1⅝ in. and 2¼ in. nuts; dimensions, H1 should be minus $\frac{1}{16}$, and H2 plus $\frac{1}{16}$."

Discussion on Castle Nuts.

Mr. De Voy—Referring to the size of cotter, the committee thought best not to recommend any particular kind of cotter pin, but if it was desired to use the Player pin it could be done.

The President—We ought to take some action on this report. The subject seems to me a very important one simply from the point of view of adopting a definite standard for these nuts, so that we may be able to induce manufacturers to put down machinery for making them and see if they cannot be made more cheaply in quantities than is possible when only a small number is manufactured. Before disposing of it, the matter should, I think, be referred to a ballot of the association, but before referring it to letter ballot I think the minority report should be considered. Mr. Austin's principal objection, as has been told you by the Secretary, is to the thickness of the nut. He considers that the thickness of the nut should be the United States standard thickness. The committee, on the other hand, has recommended a greater thickness than the United States standard for the regular sizes of castle nut. Mr. De Voy, do you recommend turning the thread for the outer end of the bolt?

Mr. De Voy—This committee thought that it had done all it could if it recommended a nut. That is about as far as we care to go. We do not care to say anything at all concerning the bolt, leaving that to the option of the members. Referring to Mr. Player's objection, we got just as far as near to the nearest sixteenth as it was possible, and let it go at that. There is no recommendation for finishing other than what is noted, so that it is about as near as you can get in a forged nut. We thought we would get as near to the ordinary practice as it is possible for us to do.

The committee also left open the question of drilling two holes instead of one.

H. T. Bentley (C. & N. W.)—We have had a great deal of difficulty with the castle nut breaking. We had that difficulty with engines from the locomotive builders and also with nuts purchased from manufacturers. I have taken up the matter with both concerns, to see if they would make a steel nut.

In regard to the difficulty of the cotter pin coming out, I suggest that if it is thought advisable to use a cotter pin, it be split at the ends, as has been the practice frequently.

In regard to two holes, while that practice is not within the province of the committee to speak about, I think on the larger sized bolts it is absolutely necessary to have a second hole, so that final adjustment can be made, and I therefore suggest that people who go into the use of the castle nut should use the two holes, as that practice will certainly facilitate the ease with which the adjustments can be made.

F. H. Clark (C., B. & Q.)—It seems the principal point of difference between the nut recommended by the committee and that which Mr. Austin has in mind is that the committee recommend a taper nut and recess the top portion of the nut, removing the thread. Mr. Austin feels that a somewhat shallower nut would be satisfactory, but that the thread should be continued the full length of the nut. It seems to me there are some advantages in that construction, and I should like to know what objections there are to it from the standpoint of the committee.

David Brown (D., L. & W.)—The use of the castle nut will undoubtedly assist us very much, but I think we should complete the matter by giving all dimensions. I have seen nuts for a 2¼-in. bolt reduced down to ⅜ in. at the bottom, and did not wonder at them splitting. We should make a decision on what size we intend to have the nut, as regards depth, and

the size of the slot, and we certainly should decide on the size of the pin, so that we will all use the same sizes, but we should bear in mind to make them as large as we possibly can. Some roads now use a ⅛-in. nut, another a ¼-in., etc., whereas if we decided they should all be ¼ in. or ⅜ in., whatever size the bolt should have, it will make the practice uniform, and duplicates can be easily obtained. We certainly should have depth enough to keep it from splitting.

The President—Mr. De Voy, do I understand the committee has recommended taking the threads off the nuts? You are recommending tapping the nuts straight through?

Mr. De Voy—Yes.

The President—The only point raised by Mr. Austin is that in the plate shown in the report, the end of the bolt is shown straight instead of threaded, which is a matter you do not deal with.

Mr. De Voy—We do not care to make any recommendation on that point.

The President—You are simply providing a standard for the nut?

Mr. De Voy—That is all. We want it to go as far toward the present practice as possible. I do not think it is in the province of the committee to say how far the bolt should go on the nut, or what the method of tapping should be. When you get home and plat these different nuts out you will find it difficult to fit absolutely within the range of dimensions you have been using on your standard nuts, that is, as far as length and depth of slot, etc., is concerned. We believe we have done as near what came within our province as was possible. In reference to the so-called Player cotter pin, that is really the one that was proposed by the American Locomotive Company. At the meeting of the committee, on account of the slight differences of opinion, particularly on the part of Mr. Player, as to whether we would have a Player cotter pin in the report or not, we finally compromised with Mr. Player in order to get home on the train that night, and called it the Player cotter pin. You can call it what you like.

The President—In order to get the matter straight, would it not be as well to take the sense of the meeting on the two points raised by the minority report?

The first point is as to whether the nut should be the U. S. standard in thickness and not more, or the thickness recommended by the Committee. I know we are using the thickness recommended by the Committee, and would not care to go down to the U. S. standard thickness for the majority of our castle nuts. I think if we take up that point and decide it, then we could take up the second point and make a possible recommendation.

Mr. De Voy—You will find that the reference to the U. S. standard is only as concerns the length of the nut. It does not have anything to do with the depth. It is really immaterial, and you cannot adopt the U. S. standard for length and obtain the proper depth of castle required for a cotter pin and for a taper pin. If Mr. Austin wants to use a thickness other than referred to in the report, it is up to him to do it. It is not any trouble to change the dies for that purpose. It is a question which the committee left open.

G. W. Wildin (N. Y., N. H. & H.)—I move that the association accept the committee's report as the standard of the association as to thickness.

Motion carried.

The President—The next point is a misunderstanding as to turning the thread for the outer end of the bolt, because it is not referred to in the report and is immaterial, so, if there is some objection, we will not consider it.

The third point is the style of cotter pin. The committee has shown three styles of cotter pin, what is known as the Player cotter pin, the ordinary cotter pin and the taper pin. The point to settle would be as to whether or not we should eliminate the Player cotter pin and the taper pin from the report, or adopt all three.

C. A. Seley (C., R. I. & P.)—I move that the cotter pin shown in plate No. 4A stand as the cotter pin approved by the association.

Motion carried.

H. P. Meredith (Pennsylvania)—Our committee reported on standard castle nuts, and has given you three strings to your bow as to the method of preventing the castle nut from turning. We thought it was advisable to do that, because we do think there are some good points in favor of the design of cotter submitted by Mr. Player, and we do know it is the desire, at least of some roads, to use the taper point. Therefore we show the taper point and lengths required for each size of nut, for the reason we have to show which method of fastening the nut or preventing it from turning was best suited in each case. We laid down our standard for the depth and width of the slot in the top of the nut within the range of these three methods of fastening. I think, therefore, that all three of the methods of fastening shown be left standing as they are. There is nothing compulsory as to what method each railway shall use. We have standardized the nut.

Mr. Wildin—When you get engines constructed at locomotive works—for example, at the American Locomotive Company's Works—they would use in the latter case what is called the Player cotter. It might be the practice of your road to use a taper pin, and you would either have to get down to small details in your specifications and require that the taper pin be used along with the castle nut, or you could not use the nuts on the engine interchangeably with your other engines.

Mr. Gaines—I think the question of the cotter pin is far from the point at issue. What we want is a standard castle nut, so that we can obtain them, if necessary, from outside manufacturers. We have a slot in the nut that will take one of three or four pins, and I think the discussion of the specific character of the pin, or method of fastening, is out of order in this discussion.

The President—This discussion is out of order, under any circumstances, as the plate No. 4A has been accepted by the association.

A. W. Gibbs (Penna.)—In connection with plate No. 4A, will the committee explain what use it proposes to make of that thin nut with the special thread of 8 threads ranging all the way from 1 in. to 3 in.? I think most of the members will recall how much trouble there was in getting the length standardized. When you propose to go away from that standard, good reasons should be given. We have had one serious breaking away in the case of the automobile people in using nuts of small size with less threads. Here is another proposed breaking away. Unless there is a good reason for this, I think we should stick to the U. S. threads, even if we have to make use of liners.

Mr. De Voy—That was provided to take care of the bolt which was revolving or in motion, in which there was a possibility that another style of thread would be used. I was in hopes that the member of the committee from the Pennsylvania Railroad would have answered that, because it is really one of the pins he requested. It is simply designed to take care of special cases.

Mr. Gibbs—There should be some way of explaining what you have in mind, because the use of that, I imagine, might cause serious confusion.

Mr. De Voy—The point is well taken.

Mr. Wildin—I move that we eliminate all dimensions referring to the bolt on plate No. 4A and also all those referring to special threads in the nut on the same sheet.

Motion seconded.

Mr. Seley—I hope that motion will not prevail. I believe that there are very many locomotives in the United States with thin crank pin nuts that are United States standard threads. Here is an opportunity to get together. So far as I have studied the question the number of threads is quite acceptable. I believe the table should be maintained as it is.

C. B. Smith (B. & M.).—In reference to the use of United States standard threads on crank pin nuts it has been the practice of the Boston & Maine on all new work to apply the United States standard threads.

Mr. Seley—On crank pin nuts?

Mr. Smith—Yes.

Mr. Seley—How thin?

Mr. Smith—The thickness of ¾ in., or possibly ⅝ in. There was an insistent demand that that should be done, and in introducing special taps it would be required in tapping the nuts.

F. F. Gaines (Central of Georgia)—I agree with Mr. Seley. I think we must have these special nuts. While there may be an exception or two to the United States standard on thin nuts, the majority of the roads are using standard nuts on crosshead pins and knuckle pins of finer thread. I think we should keep it in.

F. H. Clark (C. B. & Q.).—I agree with Mr. Gaines, and Mr. Seley, that fine threads are probably desirable for certain parts, but I do not believe that we should adopt the recommendation to change our pitch to conform to the recommended standard. I presume the pitch and diameter varies considerably on different railways, and I believe that we should stick to what we have, whether it is standard or not, rather than make a change. I know that would be true in our case, and would probably be true in the case of other railways.

Mr. De Voy—I do not understand the reason for this discussion. We have tried to cover every case we know of, so that you will not be tied up in any way relative to the thread. If you look at your locomotives you will find that you must have special threads. You will not do away with these special threads. Why not be consistent and vote for just what you will do when you get home? I do not understand this discussion relative to the number of threads. You are not tying yourself up in any way in regard to the number of threads,

and there is nothing in this report that the committee has not argued pretty well. It will suit you all if you will try it for a few years.

Mr. Seley—It appears to me we are trying to start a standard for the manufacturer, not necessarily the railway standard. If the manufacturers line up their practice and we can get castle nuts of approximately the standard shown in the plate and have thin castle nuts and other bolts where they want a case-hardened nut completely finished by the manufacturer, we would probably get a better price and better delivery on a standard than on an odd thread. I do not care if three-quarters of the railways do not follow it. If the other quarter does, they will get the advantage with the manufacturer of standard material, and I believe in starting with a quarter if you cannot start with three-quarters.

Mr. De Voy—I move that the report of this committee as a whole be referred to the association for letter ballot.

The President—That would have to be an amendment to Mr. Wildin's motion.

Mr. De Voy—I move it as an amendment.

M. D. Fraley (L. S. & M. S.)—In seconding the amendment to the motion, I would say that I believe the committee has presented to us a very complete report on the question of castle nuts. I believe that the subject is fully covered and it is within the province of each railway to use whatever standard they see fit. I believe they will make no mistake in adopting the first standard recommended, and they will find it is possible to use that particular dimension in every bolt on the locomotive, with the exception of possibly a few knuckle joint pins or crank pin nuts. If those sizes are required specially, it is within the province of the user to so order them. I believe the convention will make a mistake if it does not accept the report of the committee as presented.

The President—Mr. Wildin made a motion to eliminate from plate No. 4A all dimensions referring to the bolt, and also all reference to special threads in the nut on the same sheet. There is an amendment to the motion, proposed by Mr. De Voy, that the report as a whole be referred to the association for adoption as standard. That is hardly an amendment. I think it would be really better to vote on Mr. Wildin's motion first and settle that.

Mr. De Voy—I am going to vote against Mr. Wildin's motion, but I do not like to vote against it all, so that if you can get at it by some other method it would be just as well.

Mr. Wildin—Mr. President, I just want to say one word more if I am not out of order. My object in making the motion was this. We have been going on for a number of years establishing standards in ordinary nuts for this association, and we have never got down to specifying the special nuts. Now, when we come to the castle nut, we are all right in going so far as we can in specifying it for a U. S. standard nut. When we go further than that, we are going further than we ever went in the ordinary nut. I do not think anybody will pay any attention to it anyway, and I see no use in burdening our reports with stuff that nobody will pay any attention to when we get home.

The President—In order to keep this matter straight, we will divide Mr. Wildin's motion into two parts and vote first on whether the number of threads per inch for specially thin castle nuts should be accepted by the association and retained in the report.

The President—The next portion of Mr. Wildin's motion is as to whether we should retain the dimensions of the bolts. Mr. Wildin moves that the dimensions of the bolts should be taken out of the report.

Motion defeated.

Mr. De Voy's motion, that the report as a whole be accepted and referred to letter ballot of the association for adoption as a standard, was then carried.

Secretary Taylor then read the report on Safety Valves.

Discussion on Safety Valves.

There was no discussion of this report. The committee was continued to carry on the investigation.

The report on Superheaters was read by Mr. Seley.

Discussion on Superheaters.

Mr. Seley—It is desired to submit some information obtained since the Superheater Committee report was printed. This consists of the results of some passenger engine tests made on the Illinois division of the C., R. I. & P. this year between April 18 and May 11. This division is 181.2 miles between terminals, no heavy gradient nor curvature.

The trains were Nos. 11 and 6. The average total time was 4 hrs. 24 min., and the average running time, 4 hrs. 9 min. The average number of stops was 7, and the average speed, actual running time, 43.7 m.p.h. The average number of cars in trains was 7.58 and the average weight of trains 425 tons.

The coal was sacked and weighed and the water measured by tank calibration and three round trips ran with each engine. There were five engines tested, two with superheaters and three non-superheater simple engines.

Test engine No. 4 was a new Pacific non-superheater engine which had just been received on the road, in very good shape, and she gave a practically perfect performance. The water economy was 1.62 lbs. of water per ton mile, which figure, for the purpose of comparison with the other engines, was taken as 100 per cent. The pounds of dry coal per ton-mile were 0.1826, also rated at 100 per cent. Test engine No. 1 was an Atlantic type, with superheater, that had made 62,347 miles before the test was made. Its performance was 1.36 lbs. of water per ton-mile, or 84 per cent. of the performance of the base engine. Due to the poor condition of its boiler, on account of the time it had been running, 62,000 odd miles, the performance in coal was 0.1816, or 99.4 per cent. of the base engine performance. Test engine No. 2 was a Pacific type superheater engine which had made 35,504 miles before the test. Its record was 1.37 lbs. of water per ton-mile, or only 0.01 of a pound difference from the first engine, and its percentage of base engine was 84.5. Its coal performance was 0.1655 lbs. of dry coal per ton-mile and 90.6 per cent. of the performance of the base engine. No. 3 was an Atlantic superheater that had only made 5,260 miles, in very good condition. The pounds of water per ton-mile were 1.53, or 94.4 per cent. of the base engine. I consider the explanation of this is that the engine was somewhat better suited to the weight of the train than the base engine. The performance of this engine in coal was 0.1926, or 100.5 per cent. of the base engine. No. 5 was a Pacific non-superheater that was a shop candidate, and in fact went to the shop directly after the test, having made 77,281 miles. Her performance in water was 1.774, or 109.5 per cent. of the base engine. The pounds of dry coal per ton-mile was 0.2309. or 126 per cent. of the base engine.

The two superheater engines, notwithstanding the fact that they had made respectively 62,347 and 35,504 miles before the test, did their work with 16 per cent. less water than a new non-superheater engine. The coal performance is not so high as in water, as would naturally be the case in comparing the performance of a new clean boiler and one after 62,000 miles' service, so that No. 1 shows but a trifle of advantage, but No. 2 nearly 10 per cent., which, in connection with the 15.5 per cent. water economy is certainly a fine performance.

The low record of No. 5, aside from its general condition, is no doubt partly due to having a different proportion of cylinders and smaller wheels than on engine No. 4.

The fine performance of engine No. 3 is no doubt due to its proportions being very well adapted to the weight of train and character of road, while no doubt engine No. 4 could have taken a heavier train with as good or better results, these engines being designed for heavier service than the trains on which tests were made.

Some of the dimensions of the engines tested are given in the following table:

No.	Cylinders.	Drivers.	Steam pressure.	Grate area.	Total weight, engine and tender loaded.	Tractive power.
1	21 x 26	73	185	44.86	335,300	24700
2	22 x 26	69	190	44.86	366,000	31000
3	21 x 26	73	185	44.86	330,300	24700
4	23 x 28	73	185	45.00	376,000	31600
5	22 x 26	69	190	44.86	362,000	31000

The Rock Island superheater engines were acquired in 1905 and put in service to ascertain their ability to do business without causing train delays or unduly increasing maintenance expense due to the superheater features. It was felt that these were matters of detail that should be worked out before any records or tests for economies were necessary or advisable. We had a number of difficulties of one kind and another, but through them all the advantages due to the superheater features were sufficiently apparent to warrant the effort to overcome them, which we have now done in large measure and feel confident that the showing here made is an honest, consistent one.

Prof. Goss' paper on Locomotive Performance under Saturated and Superheated Steam was next considered.

Discussion of Paper on Locomotive Performance Under Saturated and Superheated Steam.

In the absence of Prof. Goss, Prof. E. C. Schmidt, of the University of Illinois, presented his paper.

(Prof. Schmidt gave an abstract of the report referred to.)

The President—I think that we should extend to Professor Goss our hearty thanks for the magnificent report that he has compiled for us, and to Professor Schmidt for the able way in which he has presented it.

Mr. Seley—Mr. President, I take great pleasure in moving a cordial vote of thanks of the association to Professor Goss, and to Professor Schmidt, on the lines of your suggestion. (Motion carried.)

The President—The paper is open for discussion.

Mr. Seley—I wish to call attention to the absolute parallel in the results obtained in the test which I gave supplementary to the report, and in the final conclusions in Professor Goss' paper. I have not seen Professor Goss' paper before coming to Atlantic City, and it is a great gratification to find the agreement between a road test and a laboratory test.

Robert Quayle (C. & N. W.)—The paper is put together so well that "a wayfaring man, though a fool, need not err therein." It is so elaborate, too, that I believe it behooves every one of us, when we get back to our homes, to just set ourselves aside from our business for a little while and take it up, paragraph by paragraph, and know more about it—find out just what it means.

One thought expressed here is, that we will not expect to get these same values, or percentages, or reductions, in the use of fuel that are shown in this paper. I think that is true with every test that we make. When we are out on a locomotive-making special test everybody is alert. The fireman is doing his very best, he is not "slugging" the fire, as we say in railroad parlance, but he is distributing the coal at proper intervals and in proper amounts at each interval, so that combustion is being properly taken care of in the firebox, the products of combustion are being consumed there, and we are getting the results from the heat rather than letting it go out of the stack. The superheater that we have, which is of the same type as here experimented with, was used from May to October of the following year, without any repairs being made to it, or changes of any kind, and the man that was running the engine, and running it almost continuously, making 276 miles every day, said that if he couldn't have the superheater on the engine he would like to buy one; he always considered that his engine, with the superheater, was a "sleeping car" better than the engine without it. We did not, however, find that he was doing his work with very much less fuel when we came to get our monthly statements in. Sometimes we thought that he did and at other times we were quite well assured it was not so. But when a man has an engine that will do a little better than the other fellow, it may not be in evidence in the performance sheet because the train despatcher makes him do just a little more work, and he does it.

We are endeavoring now to have an engine made, built along with some others we are getting, with the superheater, and expect during the next year to make some exhaustive tests, as nearly accurate as we can, in road service, and find out more as to results, and I am sure that this most excellent paper will give us a line-up on not only what we might expect, but how to do the work in order to get the results.

J. B. Elliott (C. P. R.).—On the Quebec section of the Canadian Pacific, this is the first year we have been able to run 120 per cent. engines. We were very anxious to make the time with what is known as the "Empress Special." The district master mechanic, being a locomotive engineer, said: "Mr. Elliott, if you will let us have a superheated engine I think we can make the time you want us to make." I said, "I don't wish to pull superheated engines from the other sections, but I would like to see what you can do with superheated compared with non-superheated engines of the same class, just out of the shop about the same time." We found that we could not make the time with the engines that did not have the superheater. We are running that train now with superheater engines and making excellent time; no engine failures that amount to anything.

J. Snowden Bell—There was a paper by Prof. Thurston, which was published, I think, in 1896, in the Transactions of the Society of Mechanical Engineers, in which he says that in 1860 superheating was tried on the Baltimore & Ohio by bending some of the tubes up into the steam space, and he states that the result was a serious cutting of the cylinders. Mr. Cromwell, of the B. & O., made a very careful examination, but was not able to find any records whatever of any work of that kind having been done. It must have been done prior to 1860, because Mr. Tyson left the road in 1859. I assume that the difficulty is more apparent than real, especially as I have heard no objection of that kind lately, but I think it would be well to know from some of the gentlemen who have been using superheaters whether any objection of that kind has been developed, and if so, to what extent.

A. E. Manchester (C., M. & St. P.)—A year ago we listened to a very able paper of the results obtained from the compound engine and the simple engine as tested on the Pennsylvania plant. I am sorry that I have neglected to make a comparison of the results as shown in that paper with the paper under discussion, and I rise now to suggest, or ask, if the gentleman who presented that paper a year ago is here; if so, that he just give us the results on the Pennsylvania testing plant as compared with the results in the paper. My recollection is that the results obtained on the Pennsylvania plant were a fuel economy of something like forty-three per cent., and the results given here by Prof. Goss range from four to sixteen per cent.

L. R. Johnson (Canadian Pacific)—I believe there is no road on this continent which has so large a proportion of superheater engines to-day as the Canadian Pacific, and I would like to answer the question raised just now in regard to the difference in the conditions in which we find the valves and cylinders on the superheated engines and the saturated steam engines. From my experience (and I have had continually a large number of these engines of both types in the shops) I find there is hardly any difference at all. There is nothing, certainly, to cause any fear on anyone's part as to adopting superheated steam with the idea of its giving bad results in the cylinders and valves. I have not yet come across a single engine which shows any bad results from the use of superheated steam in either valves or cylinders.

C. E. Fuller (Union Pacific)—I would ask Mr. Johnson whether he is using superheaters on engines equipped with balanced valves or piston valves?

Mr. Johnson—Piston valves.

Mr. Fuller—Are any of the members using slide valve with superheat?

The President—We have done it, but we took the superheaters off last year.

Mr. Fuller—The reason I ask the question is that we are running a slide valve engine with a superheater, and we had a lot of trouble on account of the valves cutting. I am sorry I have not the full information, but, if my memory serves me correctly, we have overcome a great deal of it by the application of bronze seats—false seats—in place of cast iron. That is the only change that has been made.

I would ask another question from the Canadian Pacific. That is as to whether or not they are maintaining 200 lbs. pressure with the superheater, or have reduced the pressure with the superheater?

Mr. Johnson—We keep the same pressure.

Mr. Fuller—Do you use the same sized cylinders or have you increased the size of the cylinders?

The President—We have increased from a 21-in. cylinder to 22½-in. on all our freight engines, but retained the 200-lbs. pressure. Recently we noticed that the engines were not quite as snappy with 22½-in. cylinders, and 180 lbs. of steam, as with 21-in. cylinder and 200 lbs. of steam. The difference is hardly enough to notice in the freight service, but we do not want to take any chance at having a passenger engine as all "logy" on account of having too small a valve.

Apart from my own impression, I'll say that our talks with our various master mechanics, and the superintendent of motive power of our Western lines, which really constitute an independent organization to a great extent, are such that the question of applying superheaters with us never comes up. We look upon it just as much as an attachment to the locomotive to-day as we do the cylinders. We would not think of giving it up. The only question is as to what type of superheater we shall use, or what shall be done to take care of it and things of that sort. We have not for the past two or three years really seriously considered the question whether we should use the superheaters or not—they have been used as a matter of course. We have between 200 and 300 compound engines, and the other day a request came from the general manager of the western lines that he wanted some compounds, that were bought only four years ago, converted to superheaters for the sake of the economy in the maintenance. Superheater engines are so much cheaper to maintain that he wanted the change made for the sake of his accounts.

I am in a rather peculiar position with respect to this report. We have always said we got an increased economy of from 10 to 15 per cent. in freight service and 15 to 20 per cent. in passenger service from the use of superheated steam, and these figures are rather higher than could be justified, based on Professor Goss' report; in other words, we are not in the position of finding that we do not get as good results in practice as are given on the testing plant, but we are in the position of having given actual coal chute figures extending over months of service, which show a higher economy than can apparently be justified by the experiments conducted by Professor Goss. There is no possible criticism that could be made of Professor Goss' experiments. No practical road test could compare with them for a minute in accuracy or the care with which they are conducted, but I think there are one or two things which enter into road conditions that must be taken into consideration. In the first place, this superheater is applied to a comparatively small engine. You will notice that the number of 2-in. tubes is reduced from 200 to 111 by the application of the superheater. In applying it to a large modern engine we do not reduce the amount of evaporating surface to the same extent, in applying the superheater, as has been the case in this application to a small 16-in. engine.

I have always said, not from a scientific standpoint, but from our practical observation, that, peculiar as it may seem, we have always found more saving in coal than we had in water. That is the universal experience of our men. The saving in coal is more than the saving in water. The result of this test would not indicate that. All I can say is it may be due to the fact that the boiler of this engine is disturbed more by the application of this superheater than the boiler of a large engine would be, in which so much heating surface was not cut out.

Another matter of importance is this: In testing plant work, whether you are testing superheated steam engines or saturated steam engines, you can practically depend on perfect hand firing. The men are used to uniform conditions, maintain the fire in a perfect condition, and whatever the rate at which the work is being taken off the engine, the firing is practically uniform. That is exhibited closely in the heat balances. There is no tired fireman, no shoving in any amount of coal in order to get along in the test-plant work. If you apply a device to a locomotive on hard runs that is going to mean that the demands on the boiler are 15 and 20 per cent. less at the time the engine is working hard, you are not only going to save the coal shown on the test plant, but you will have a more efficient fire, because you are firing within the limits which the fireman can attend to instead of putting him up against a job which he will neglect and fall down on. I think we save in the firemen.

Those who have compared testing-plant results on saturated steam, with the results secured from road tests on saturated steam have found a considerable discrepancy. We do not operate as economically on the road as on a testing plant. I can only put that forward as a suggestion, but it is possible, if you lighten the work of the firemen; and I can say that we have not a run with a superheated steam engine where the fireman is taxed at all. Even when the engine is working hard, on a hill, the fireman is not taxed, therefore with engines the size we are running, it is possible we get a certain amount of saving from that source that would not occur in the testing plant.

Another thing we should remember is, that when we had the report from Prof. Goss on saturated steam, he called attention to the fact that we could hardly regard the laboratory results at high pressure as the equivalent of road results; that while they were running the Schenectady No. 2 at 160 lbs. pressure there was comparatively little difficulty in maintaining the packing and the joints tight, and that sort of thing, whereas in the tests of engines at 200 to 240 lbs. pressure they were continually attending to these details to keep the engine in proper condition.

In comparing an engine at 160 lbs. with one at 240 lbs., we were told, and undoubtedly correct, that you could not expect to get, by going to 240 lbs., the increased economy that the test results on saturated steam show, simply because you could not keep the engine up in the same manner in which it was kept on the testing plant, if you used the high pressures. So, if you grant that high pressures for simple engines are very questionable in practical use, you must also grant that the practical engine running at 160 lbs. and using superheated steam should be compared with the saturated steam engine running at 160 lbs., and not with the saturated steam engine running at 240 lbs.

Professor Goss has called attention to the use of steam at a temperature of 660 deg. F. abroad. I am pleased to have him do that, as there have been many criticisms of the fire-tube superheater using steam at a temperature of about 550 deg. F., which has been equaled in superheater steam engines. As a matter of fact, that would not be known as high superheat abroad, but medium.

One speaker asked about cylinder troubles. We have had a great deal of trouble in the past few years with piston rings, but very little trouble with valve rings; but we did have considerable valve trouble. Now, strangely enough, when we first went into superheating, we did not have much trouble in that respect, and I can only say that I am not at all satisfied yet whether our trouble is due to superheated steam or due to changes in our foundry practice. Roads using saturated steam have occasionally had serious packing troubles, the wear of piston rings, etc., depending on the metal being porous. We are going into the question of improving our packing, and think we are obtaining considerably better results. The trouble does not occur in all cases, but it is a serious question with us; that is to say, we have rings that have worn out as quickly as six weeks or two months, and others will last eight or nine months. We have experimented with the substitution of Dunbar for split-ring packing, and we have found that has lasted some nine or ten months without renewal, and we believe, after we use the Dunbar packing generally, we will have no serious trouble with the cylinders. The bushings in both the cylinders and the valve chests are not hurt; the valve rings are not hurt, but we have a certain amount to learn about the proper material and proper style of packing ring to use. We do not consider the matter very serious and it does not show up on our repair bills.

I have spoken about failures. The other day I had our superheater failures in passenger service compiled for the eight months, from July, 1908, to February, 1909. I do not pretend to say that we have every detention in. With a road of the character of the Canadian Pacific, we are likely to have small detentions that do not come in, but the important failures, where 15 or 20 minutes or more was lost through the failure of superheater parts, are, I think, included.

On our Pacific type engines we made a total of 1,666,000 miles in the passenger service in these eight months, and there were a total of five superheater failures, about 300,000 miles for each failure of a superheater part, and three of these failures were on the same engine on successive days. Taking the failures that have occurred on passenger service engines equipped with superheated steam we have, for a total of 1,777,000 miles, nine failures—about 197,000 miles for each failure of a superheater part. But in that statement I am unable to allow mileage credited for certain mixed traffic and freight engines that have made passenger mileage during the time. I do not want to put this statement forward as a very accurate one—it is so good that I have sent it back to the motive power department, and also to the transportation department, to have it checked—but I wish to present it, and I do think it shows that the extent of superheater failures, with reasonable maintenance, is not going to be serious.

F. F. Gaines (Cent. of Ga.)—About two years ago, when we were ordering a number of locomotives we had one equipped with this superheater and one with a feed-water heater. The superheater engine has slide valves, and we enlarged the cylinder 1 in. to get the steam pressure down to 180 lbs., against others with 200 lbs. The engine has given no trouble at all with the valves or piston. We are not employing a high degree of superheat, only a moderate one, but it has been a very satisfactory engine. It is a favorite with the engineers, and the repairs have been very slight.

The peculiar part of the situation arises in connection with coal economy. Our feed-water heater engine has the superheated engine greatly outdistanced in this respect—there is no comparison. Without desiring to throw cold water on the superheater proposition, as carried out in other railways, we have had such excellent results from the feed-water heater that we rather lean that way.

In regard to both engines in comparison with the plain engine: Whereas the plain engines requires their pipes to be taken out and the flues renewed after a year's service, the engines with the feed-water heater and the superheater will go longer before requiring any attention to these matters. The use of the feed-water heater and the superheater does not have the same effect in the construction of the flues that you get through putting cold water into the boilers.

G. W. Wildin (N. Y., N. H. & H.)—I believe they have two types of superheaters on the Canadian Pacific. Mr. Vaughan did not mention whether it was the Schmidt or Vaughan-Horsey type to which he referred.

The President—They include all types.

Mr. Wildin—What type gave you the most trouble? About a year ago you were in my office and gave me quite a shock about superheaters. You told me you were ready to advocate them for passenger engines, but that you were not ready to advocate them for freight engines. I presume your conversion has come about since a year ago, as you say there is no question to-day, when an engine is being designed, that a superheater should go on it.

The President—I do not think you give my position correctly. When I made that statement I was not talking about our conditions. I have always taken the position that I believe that through passenger engines should be equipped with superheaters, and I do not care what the price of coal is. It is worth it for the capacity you get in the engine. Whether you equip your freight engines with the superheater is a question of the cost of coal. I doubt if it will pay a road with cheap coal to put superheaters in service. So much coal is lost lying around on side-tracks and in yards, that economy in the use of superheaters is not realized in the consumption of coal, and I think that the application of superheaters to freight engines is a matter for later development; but in the passenger service there is a big saving in the work demanded of the firemen—we estimate the increase in the capacity of the firemen at 10 per cent.—and a saving in coal has shown up better in the passenger service than it does in the freight service. I feel, as a general proposition, that superheaters should be applied in the passenger service without any question, and as for freight service, that will be a matter for future development.

Mr. Wildin—What price of coal would you draw the line at?

The President—I would not worry as to what price of coal

should serve as a limiting line in the application of superheaters to engines in freight service, until you put them on the engines in passenger service, and then you will find out whether you want to put them on the engines in freight service.

Prof. H. Wade Hibbard (Univ. of Mo.)—The statement is made on page 44: "The results sustain a claim which has been put forward by advocates of the practice of superheating to the effect that the adoption of such practice permits a material reduction in steam pressure as compared with pressures now common in locomotive service, without materially sacrificing efficiency."

I believe that that statement should be taken with a mental reservation that the information upon which it is based is obtained from the use of only 150 deg. of superheat, giving the superheat curve in Fig. 30 its bottom or most efficient point at 200 lbs. boiler pressure. Unless the information is given to us that that same curve will be retained with a greater degree of superheat, then we should not be too sure of the usefulness of this sentence I have just read. We know that with the general introduction of the Mallet compound locomotive we may very likely have that bottom point in that curve shoved toward the right, enabling us with a higher degree of superheat to carry also a higher steam pressure, and still obtain a greater degree of efficiency. Especially when we consider the engine with the boiler, and refer to Fig. 8, which gives the evaporation per pound of coal under different conditions of pressure, we find that practically no more heat is required to evaporate a pound of water at the higher pressure, and that, in connection with the use of the compound locomotive, should enable the use of a higher degree of superheat without wasting the heat into the atmosphere. Of course, the motive power department naturally wishes to make a locomotive which is the least expensive to keep in repair and the least costly in the use of coal and water. But the motive power department should forever keep in mind that the stockholder is not so much interested in the economy of the motive power department as he is in the economy of transportation as a whole. If with higher superheat and higher steam pressure combined there should result greater hauling capacity or speed per ton of locomotive, thus gaining economy of transportation as a whole, then the motive power department will have to accept the higher pressures, rather than to take a retrograde step towards the lower pressures—a retrograde position, let us say, from the point of view of efficiency of transportation, though apparently not retrograde from the point of cheapening the cost of boiler maintenance. So I think this sentence which I have quoted should be read with the fact in mind that it is based only on the figures of 150 deg. superheat, and that until we have figures showing the shape of the curve at higher degrees of superheat we should not place too great dependence on that statement.

A. Sinclair—I think from what I have seen of the use of superheated steam with locomotives that the difficulty may be to a great extent imaginary. In regard to the economy obtained on the testing plant, I think it is quite probable that the economy in road service may be very much greater than it would be on a testing plant with superheated steam. The principal saving, due to superheated steam, is that it diminishes the immense waste from cylinder condensation. Isherwood, the famous Engineer of the United States navy, made a very exhaustive series of tests on cylinder condensation, and he came to the conclusion that the cylinder condensation took away the advantages of short cut-offs of increased expansion. Now, I think that a locomotive, with its cylinders so badly exposed as they are in road service, and with the boiler swashing the water to some extent into the dry pipe, it is likely that the steam is much wetter when it is exposed to the superheating gases than it is on the testing plant, and therefore that the superheater has greater work to do in drying the steam on the road service than it has on the testing service. I think it is very likely that under these conditions the superheater may be a great deal more beneficial in road service than is demonstrated in the tests on the testing plants.

L. R. Pomeroy—I wish to call attention to one point spoken of inferentially in the report, and it would go to show that, practically, the locomotive boiler with 180 lbs. pressure is as serviceable, with the use of the superheater, in producing like results, as one of 210 lbs. pressure without the superheater. Supposing that the initial cost, and the cost of repairs generally speaking is somewhat proportional to the pressure, there is a saving due to first cost and maintenance that should be credited to the superheater. The difference between 210 lbs. pressure and 180 lbs. pressure is 15 per cent. Suppose 3 per cent. on cost of repairs should be saved in that reduction, that surely should be added to the economy of the superheater.

M. J. Drury (Santa Fe)—We find by the introduction of the superheater that we have reduced the repairs on our fireboxes, and have also reduced the expenses attendant upon cylinder packing and valve bushing.

H. W. Jacobs (Santa Fe)—I have lately had occasion to get some figures on five superheater engines that were formerly saturated steam engines. The reductions in repairs to these engines were from 23 to 33 per cent. We find with our superheater engines that there is no additional cost for cylinder packing or for the valves.

G. R. Henderson—Were the pressures in both cases the same, or was there a different pressure?

Mr. Jacobs—In saturated steam engines 225 lbs. pressure, and the superheated engines 160 lbs. pressure.

Mr. Henderson—That is responsible for the saving.

C. E. Chambers (C. of N. J.)—Were the tests made in both cases just after the engines were turned out of the shop or was one engine tested after being turned out of the shop, and the other after the engine was out on the road for some time?

Mr. Jacobs—Both engines were tested as they were turned out of the shop. Another thing I would add is the very satisfactory manner in which the firemen and engineers take to these engines. They seem to be very much in favor of the superheated engine.

F. C. Cleaver (Rutland)—I have been looking up the question of superheat during the last two months and find that the claims made for superheated engines are substantiated in my experience; that is, I find that the men are in favor of them, they prefer them to the saturated steam engines, and almost invariably say that the superheating feature gives little trouble. You know that engineers are not very favorable to things that have got to be constantly operated. It is a fact that in actual running beween certain points with the same train, in two cases that I have in mind, with exactly the same care, the same schedule, same time of day, same weather, I noted a difference of nearly forty per cent. in the amount of fuel actually consumed. That was for a short distance only and cannot be taken as reliable for long distances, only as an indication. These figures are undoubtedly too high, but that is the way they came out. I have had a good deal of experience in handling locomotives. You can pretty nearly tell, when you step on an engine that is running, even with your eyes shut, whether the engine is smart or "logy." I have ridden on a number of superheated engines and the peculiar feeling of the engine in motion indicates a smart engine. I have ridden on superheated engines and on compound engines of pretty nearly the same weights, both being of the same capacity, and the difference was very great in that respect. The engine was snappy and quick in one case and "logy" in another. I have not completed the investigation I was making, and am speaking offhand just from notes which I have made, which are not tabulated, and you must consider that in thinking about what I have said.

G. R. Henderson—Can we get more information about the point Mr. Jacobs spoke of? I understood him to say that the pressure was reduced. That must have reduced the hauling power unless the cylinders were enlarged in proportion, and if the hauling power was reduced the ton mileage was reduced. It would be interesting to know if the figures of repairs were on a yearly basis, a ton mileage basis, or an engine mileage basis.

Mr. Jacobs—They were on an engine mileage basis.

C. E. Fuller—Was it a simple or compound engine you are figuring on in the reduction in cost?

Mr. Jacobs—These engines I am speaking of were formerly compound engines.

Mr. Fuller—Do you attribute the reduction to the increased cost of maintenance of the compound, or is your compound maintenance any heavier than the simple engines? I think it has a bearing on this subject, whether or not the reduction in cost is obtained by the application of the superheater or whether it is obtained by the reduction of the compound features.

Mr. Jacobs—My belief is that a portion of the saving was undoubtedly brought about through the rather heavy cost of repairs on this particular type of compound, but nevertheless I also believe that the superheater had a great deal to do with it. I may add for Mr. Henderson's information that the sizes of the cylinders were enlarged, and they gave increased hauling power. I cannot give the actual figures, but there has been an increase, because we are able to get greater speed and the engines are much more snappy.

The President—If there is no further discussion on this subject I would ask Prof. Schmidt and Mr. Seley to reply.

Professor Schmidt—I think Mr. Vaughan's interpretation of the former publication of the saturated steam results, as regards the maintenance under high pressures, was correct and the inference he drew from these facts it seems to me are also true. It seems to me also that his remarks concerning the differences between the testing plant conditions and the condi-

tions in service and the probable results of those differences upon performance are justified.

In reply to Prof. Hibbard I would say that the sentence he read is intended to apply only to the conditions of the test, and is justified, of course, by the appearance of the curve directly above the statement on that same page 44, and in the absence of further information concerning the shape of a similar curve at higher superheats, I think the statement might be considered a justifiable one.

Topical Discussions.

Is the Additional Cost of Flexible Staybolts Justifiable?

H. D. Brown (Erie).—I wrote to a number of our members asking their experience in the matter under consideration. I presented six questions to them. For my own part I very much favor the use of flexible staybolts, and to my great surprise all the answers to my letters were in the affirmative too. Four of the replies suggested that there should be a committee appointed to work up modern methods for the application of flexible staybolts. It seems there has not been any method in universal use of proper adjustment of the flexible bolts. It was suggested that that matter should be given careful attention. Another subject suggested was that the committee, if such a committee were appointed, should tram up the boiler with reference to locating the expansion of the firebox with regard to the outside shell and the throat sheet and back heads. There was a decided request that there should be opportunities afforded of making tests to determine the best method of applying flexible staybolts to staying boilers.

H. T. Bentley (C. & N. W.)—It seems to me that it would be necessary to know whether we are breaking an abnormally large number of staybolts or not. It would seem that with a very small staybolt breakage the use of the flexible bolt is unnecessary. I believe under some certain conditions staybolts are breaking very frequently and probably in those cases a flexible staybolt would be necessary, but I would like to ask Mr. Brown if he knows what his breakage of staybolts per engine per year amounts to, whether it is with any particular type of engine he is having trouble and whether a change in the position of the firebox may not overcome some of the difficulties he may have on account of having an excessive number of staybolts broken.

Mr. Brown—In one case only did I get any information as to the number of staybolts broken. In that case the statement was made that the number of rigid or solid bolts that were broken was very large, running up into something like 400 a year. That was on the Wooten firebox. In many cases we find the cost of application of the flexible staybolt high. In other cases it runs from about 35 to 50 per cent. higher than the application of the rigid bolt.

Mr. Bentley—One of our engines gave us trouble with the staybolts and in re-designing the firebox, so as to get longer staybolts in, we reduced the breakage from fifty or sixty per year, in that engine, down to six or seven. With the type of flexible staybolt in general use, is it possible to detect whether they are broken or not?

Mr. Brown—I find the general practice is to put air pressure in the boiler and then make the test. We find it easiest to make the test by removing the cap.

J. F. De Voy (C., M. & St. P.)—I wish to raise the point as to whether any of the members have ever tried a flexible staybolt with the idea of preventing cracked side sheets. I have this suggestion to make, which I think is new: On a certain Atlantic type engine we have a boiler which has a very shallow firebox. About eighteen inches from the mud ring, and about the center between the forward and back part of the side sheet, we found it was an absolute impossibility to retain the side sheet in the boiler more than six months. There would be a crack developed at that point possibly twenty-four inches long. We increased the width by adding to the side sheet, a distance of four and one-half inches above the point mentioned to a point about seven inches below, and the additional length did not appear to help the case at all. I recommended to the superintendent of motive power that we apply flexible staybolts to what I term the cracking zone of the side sheets, or, in other words, two or three rows above where the crack occurred and two or three below. I understand, gentlemen, this is entirely at variance with the usual custom of placing staybolts. The results are more than anyone could expect. I do not know whether anyone else has ever tried this, but I would recommend the plan. It has certainly increased the life of these side sheets in this particular type of boiler. In my opinion, if the boiler was designed on different lines we would not have trouble from crack side sheets.

Is the usual front row of crown bolts in a locomotive boiler beneficial or otherwise?

C. A. Seley (C., R. I. & P.)—The function of an expansion staybolt, from its name, as well as its construction, is to facilitate the expansion of the flue sheets, as well as performing its usual duties of supporting the sheets which it connects. If the expansion stay *does* perform its duties as such, then the crown-sheet is unsupported from flue sheet to first non-expanding staybolt, and therefore the expansion staybolt is useless, because it does not support and may be left out without harm.

If on the contrary the expansion stay *does not* perform its duties as such, then the expansion feature is useless and may be replaced by a solid staybolt, giving cheaper and better construction.

Briefly, then, the condition is this: If an expansion staybolt *does* expand, it is no good, on account of not supporting the sheet. If it *does not* expand, it is no good, because it does not work.

L. R. Pomeroy—I think one of the important features of this discussion is the fact that all of these so-called flexible staybolts at the end of the crown sheet are in tension. I think the staybolts do not expand, in the sense of elongation, but rotate and allow a movement with reference to the box and outside shell which allows the box to adjust itself to the different conditions going on in the sheet and steam space.

Mr. Fowler—I want to call attention to some experiments made in the past and reported to this association a great many years ago, I think by Mr. Eddy, who was connected with the Fitchburg Railway. He put a gage on the top of the crown sheet at the front end near the top sheet, and set it back at intervals, and immediately noticed the movement of the sheet when he was getting up steam. He found that before there was any steam generation in the boiler whatever, the front of the fire box expanded the front sheet, expanded the crown sheet, and actually lifted the crown sheet and placed it near the roof sheet, so that the gage rose through the stuffing box and showed there was a perceptible decrease between the two sheets. As the steam pressure was generated and applied to the top of the boiler the gage dropped back to its natural position again and showed that the stays at the front end of the boiler were in tension. If they are slack at the front end, it allows for the rise of the sheet when the boiler is being heated, and they then go back in tension, and do their work when steam is placed on the boiler.

Mr. De Voy—I wish to correct the statement in one regard and pay a tribute to a man of the old school, who was conversant with every detail of the locomotive boiler. I refer to J. M. Boom, who was chairman of your boiler committee and conducted tests for three months during the time that I was the office boy at Frankfort, N. Y., on the old West Shore road about 18 years ago, so that if you will give credit to Mr. Boom, who presented to this convention a minority report in which he stated that the flexible sling stay at the front end of a boiler never did any good (and I never knew it to do any good), I think we will be only giving Mr. Boom just credit. I spent 2½ months on the proposition. When you first put fire in the firebox there is an expansion all around. We use the gages you referred to. Our experiments were very elaborate. When you first put fire in the firebox there is an expansion of about 1/100 part of an inch on the whole thing, inside and all. We had gages on the firebox outside crown sheet, and everything of that kind, and so while I have always been forced—wanted to be in style—to put three rows of sling stays in the front end of the boiler at the crown sheet I want to tell you there is no more necessity for it than there is in wearing two hats. I want to take this opportunity to pay a tribute to Mr. Boom.

D. J. Redding (P. & L. E.)—These things we have just heard are facts. When you have a lot of rigid bolts in the front ends of your crown sheet, after the firebox has been in a year or two, you will find the crown sheet bottled down ¼ in., and the front end of the top sheet be up in the same way. I know, from personal observation, of the introduction of sling stays which do not corrode, which overcome that trouble.

C. E. Fuller—There is more trouble caused by the boiler maker than in any other way. Keep the boiler maker out of the firebox. If you allow the boiler makers to work on your flue sheets, using different kinds of rollers and expanders, in that you will find the cause of the trouble with the flue sheets. If you see a flue sheet going up, and a crown sheet going up with it, it has been expanded and stretched by the constant rolling of the flues.

Mr. De Voy—If you expand the flue sheet do you expand the side sheet? Do they stretch and go up at the same time? I would suggest putting your staybolts 4 in. back of the row of rivets in the flue sheet and find out whether they expand. I think Mr. Fuller explained the whole thing.

The President—Topical discussion No. 1 on to-day's programme is entitled "Vanadium Steel; have the advantages claimed and shown in laboratory tests been substantiated in practice, particularly as regards the strengthening of locomotive parts?" This subject is set down to be opened by W. C. A. Henry. Mr. Henry has not prepared the paper and we have

not been able to get anybody else to do it. Unless someone wants to take up the discussion of that subject we will proceed to topical discussion No. 2, entitled "Are by-pass valves necessary on piston-valve locomotives?"

Are By-Pass Valves Necessary on Piston Valve Locomotives?

H. T. Bentley (C. & N. W.)—When piston valves were first used on locomotives it was very naturally supposed that, on account of the shape of valve and its inability to lift as a slide valve does, it was necessary to have some arrangement or by-pass that would take care of a higher pressure in the cylinder, due to compression, than the steam pressure carried in the boiler, and numerous devices were used, all having the same object in view, but each design differing somewhat in the manner operated.

In one of the valves tested it required over 200 lbs. above boiler pressure to operate, and therefore was practically useless. Others performed their function satisfactorily, while they remained intact, but the hammering they were subjected to caused them to break, which resulted in a bad steam leak that was often difficult to locate.

A double-seated valve gave considerable trouble on this account. The seat closing the steam from the atmosphere would be tight, while the other, separating steam chest and cylinder pressure, would not close, owing to the expansion of the metal, and a continuous blow would take place and much coal was wasted in this manner.

After using various types for several years, with unsatisfactory results, we made a series of tests in September, 1907, and found that under ordinary service conditions the by-pass valves were unnecessary and therefore took them off. After running the engines without them for nearly two years, but having suction valves of ample capacity, we do not find any bad effects, neither have we had any more cylinder heads broken than we did before.

Where by-pass valves are used simply to by-pass the air from one end of the cylinder to the other, when drifting, they may give satisfactory results, and probably will be better than the suction valve located outside, as the air will pass back and forth from one end of the cylinder to the other and not through the walls of cylinder to the extent it would do if drawn in through regular suction valves from outside.

With water in the cylinders the by-pass or cylinder relief valve might give some relief, but under ordinary running conditions we find no advantage.

While at a locomotive builder's recently, in talking about some proposed engines having 25-in. by 32-in. cylinders and a boiler pressure of 170 lbs. without a superheater, it was the opinion of their engineering department that a by-pass valve would be necessary, probably on account of the greater condensation that would occur in the cylinder of the sizes given, and using a comparatively low boiler pressure without a superheater. But for engines having ample steam space, using good water, and with cylinders suited for a boiler pressure of 190 to 225 lbs., we do not believe a by-pass valve necessary.

H. D. Brown (Erie)—What has your experience been in the loosening of valve heads before and after using the by-pass valves?

Mr. Bentley—We have not noticed any difference. We formerly used the rectangular ring which was continually giving trouble with the by-pass valves on. Since our T-shaped piston valve ring has been in use the breakage has been reduced to a minimum.

Mr. Brown—Have you any trouble with valve bushing breakage?

Mr. Bentley—No, we have discovered no trouble whatever as the result of taking the by-pass valve off.

Mr. Brown—About what is the average number of piston valve rings which were broken in a month?

Mr. Bentley—With the rectangular ring in one roundhouse we were probably breaking two or three a day, and with the T-shaped ring it is the exception and not the rule for one to break.

Mr. Brown—Inside admission or outside?

Mr. Bentley—Inside admission.

Mr. Brown—In that case which ring did you find fail?

Mr. Bentley—I cannot say. We have a Master Mechanic here who has a large number of piston valve engines operating, with and without by-pass valves, and you might call on Mr. Slater.

Frank Slater (C. & N. W.)—Where the rings were broken with the rectangular rings they broke anywhere in the valve. We use three rings on our road, and we find one broken as frequently as the other. My experience was they did not break until the bushing had become worn, and the constant vibration would break them. As soon as we bored out the bushing and put in new rings the breakage woudd stop. The T-rings did not wear so fast and did not break. We have very little trouble from broken T-rings. We find no trouble at all in dispensing with the by-pass valve, but I must say that the engines will not drift quite so freely, and when they do drift, if there is any lost motion in the rods or driving boxes, the engines will pound while drifting almost as badly as while working steam. In the engine with the by-pass valve the piston can travel freely from one end of the cylinder to the other; the lost motion is not taken up in the working parts, and you do not hear the pounding.

The President—A few years ago we made some experiments on this subject with engines fitted with the valve I think you are all familiar with, the American Locomotive Company's combined by-pass and suction valve of the 2-in. size, and another engine with a 2-in. suction valve on each end of the steam chest, and another engine with a patented type of relief valve, using, I think, 4 lbs. of suction in the cylinders with the American Locomotive type and 8 lbs. with the 2-in. suction valves, or the other type of valve. Consequently we had to use very extensively the regular by-pass and relief valve which is pretty common.

But there is a very wide difference between putting that valve on and saying you are using it, and having it used, if you really go around and see so many of them all blanked and not in use. In our winter conditions our men object very much to the combined by-pass and suction valve. It throws out a little steam for probably a couple of hundred yards after the engine is shut off, and they object to it on that account. It comes just as they are running into the station, and in exceedingly cold weather prevents them from seeing. We have felt, therefore, that we would go to the 2-in. suction valve, one on each end of the valve chest, and give up the advantage of a reduced amount of suction.

The committee on Widening Gages on Curves was continued.

REGISTRATION—MASTER MECHANICS.

Baker, Geo. H., Marlboro-Blenheim.
Burk, C. H., Loco. Supt., Mexican, Marlboro-Blenheim.
Blank, P. D., M. M., Louis., Hend. & St. L., Windsor.
Caracristi, V. Z.
Clark, J. H., M. M., Staten Island R. T., Shelburne.
Dillon, S. J., M. M., Pennsylvania.
Davis, David E., M. M., Boston & Maine, Young's.
DeVilbiss, G. J., S. M. P., Hocking Valley, Traymore.
Dreyfus, T. F., S. M. P., Buffalo & Susquehanna, Haddon Hall.
Dester, D. H., M. M., Philadelphia & Reading.
Ennis, W. C.
Edmonds, G. S., M. M., Delaware & Hudson, Chalfonte.
Gramah, J. A., Gen. Foreman, L. & N., Marlboro-Blenheim.
Goodrich, Max, M. M., New York & Ottawa, New Holland.
Hayes, W. C., Supt. Loco. Op., Erie, Marlboro-Blenheim.
Hibbard, H. Wade, University of Missouri, Richmond.
Herr, E. E., M. M., Pennsylvania.
Hocking, Jas., M. M., N. Y., N. H. & H., Marlboro-Blenheim.
Hoffmaster, F. S., A. M. M., N. Y. P. & N.
Hunter, H. S., M. M., P. & R., Merzine.
Hunt, H. H., American Locomotive Co., Marlboro-Blenheim.
Joughins, G. R., M. S., Intercolonial, Shelburne.
Kenney, H. A., Ry. & Loco. Engineering, Haddon Hall.
Kincaid, B. M., Inspector Penn. Railroad, Colonnade.
Morrison, E., Traymore.
Mannion, T. D., M. M., Philadelphia & Reading.
Neuffer, John G., S. M., Illinois Central, Brighton.
Olbering, A. J., Young's.
Phillips, R. H., Mgr., Sandy Spring R., Seaside.
Park, S. T., S. M. P., Chi. & East. Ill., Marlboro-Blenheim.
Rumney, T., G. M. S., Erie, Shelburne.
Schmidt, Prof. E. C., University of Illinois, Haddon Hall.
Stubbs, G. W., M. M. Gulf Line R., Windsor.
Staley, H. F., M. M., C., C. & O. R., Traymore.
Taylor, H. D., S. M. P. & R. E., Phila. & Reading, Brighton.
Waitt, A. M., Marlboro-Blenheim.
Wirt, G., M. M., C., C., C. & St. L. R., Dunlop.
Wyman, R. L., M. M., Lehigh & New England, Edison.
Zang, P. C., M. M., N. Y., N. H. & H.

REGISTRATION OF M. M. GUESTS.

Anderson, Paul F., S. T., C. N. O. & T. P. R., Marlboro-Blenheim.
Banker, L. W., Foreman Car Repairs, Pennsylvania Railroad.
Blasham, C. M., M. C. B., Minn. Tank Line, Young's.
Buckbee, W. A., R. F. E., Rutland, Iroquois.
Barley, C. J., D., Pennsylvania Railroad.
Baron, Jacob, M. C. B., K. & I. Bridge, Young's.
Burns, J. W., F., Pennsylvania Railroad.
Burton, Geo. H., Fght. Car Claim Agt., Pennsylvania Railroad.
Carey, J. T., Pennsylvania Railroad.
Clancy, Geo. W., G. S. I., N. Y., N. H. & H., Chalfonte.
Clark, J. P., Supervisor Signals, P. & R. Railway, Devonshire.

Clark, J. C., F., Reading, Clarendon.
Cox, J. M., E. E., Reading.
Detro, A. E., General Foreman, Cen. R. R. of N. J., Worthington.
Dill, Geo. S., Y. M., A. C. R. R.
Foertsch, T. A., R. T. E., P. P. R. R. R., Mervine.
French, Ernest, A. B. F., P. R. R.
Hewitt, E. F., F., P. R. R.
Hill, J. P., Storekeeper, P. R. R.
Holmes, H., Agt., A. C. R. R.
Heller, H. F., F. T., P. R. R.
Hukill, Wm. S., C. D., P., B. & W. R. R.
Jessen, Jessie, Y. M., A. C. R. R.
Jones, J. B., General Foreman, Pennsylvania Railroad.
Kamp, S. L., A. to E.-O., Seab'rd Air Line, Marlboro-Blenheim.
Kelly, W. M., F. E. S., P. R. R.
Kerr, R. M., Engine House Foreman, P. R. R.
Lowther, H. F., Asst. P. A., D., L. & W. Railway, Shelburne.
McAndrews, W. J., M. M., Delaware & Hudson, Bothwell.
McClelland, J. W., Supervisor, P. & R. Railway, Devonshire.
McCausland, J. N., Supt., Atlantic R. R.
Mitchell, C. K., Locomotive Engineer, B. & M., Young's.
Maize, W. L., P. A., P. R. T. Co., Chalfonte.
Metz, O., Engine House Foreman, P. R. R.
Mallon, S. L., Foreman Boilers, P. R. R.
Martin, Chas. W., General Air Brake Inspector, P. R. R.
Mannion, John J., Assistant Foreman, Atlantic City R. R.
Markland, W. H., Foreman Telegraph Shop, P. R. R.
Meason, H. M., Foreman West Philadelphia Shop, P. R. R.
Minnett, H., Foreman Car Repairs, Pennsylvania Railroad.
Ogilvie, James, Insp. of Equip., Com. Board of Canada, Young's.
Ohlwiler, D. R., Draughtsman, Pennsylvania.
O'Reilly, Wm. H., Apprentice Instructor, A., T. & S. F., Haddon Hall.
Perrine, W. M., General Foreman, C. R. R. of N. J., Edison.
Plummer, A. M., Foreman, Pennsylvania, Raymond.
Powell, T. S., Chief Draftsman, Grand Trunk Railroad, Young's.
Pratt, P., Foreman, Pennsylvania Railroad.
Rice, Wm. L., Gen. Foreman, P. & R., Monticello.
Riegel, S. S., M. E., D., L. & W. Railroad, Runnymede.
Riley, B., M. M., D., R. I. & N. W., Arlington.
Robertson, A. W., Chief Clerk, C. R. R. of N. J., Edison.
Seider, D. A., Rd. Foreman Engineer, P. & R., Marl.-Berkeley.
Simmons, C. A., Foreman N. Y. C., Stratton.
Schnepel, J. H., Car Dept., N. Y. C., New England.
Schall, H. W., Motive Power Assistant, Pennsylvania Railroad.
Schanze, H. C., Foreman, Pennsylvania Railroad.
Sherman, C. F., sec'y to V. P., Union Pacific R.
Stutsman, Ira G., Supt., C., M. & St. P. R., Pennhurst.
Shupert, F. W., boiler inspector, A. T. & S. Fe, Haddon Hall.
Smith, Geo. C., M. M., Maryland & Penn. R., Elberon.
Stark, T. L., G. C. I., Hocking Valley, Young's.
Thomson, S. G., Asst. Eng. M. P., P. R.
Toomey, T. H., fore. erecting shop, P. R.
Thompson, F. V., Asst. Elec. Engr., Reading.
Turnbull, A. P., Clerk, Pennsylvania Railroad.
Vyne, A. G., Round Foreman, Pennsylvania Railroad.
Worman, E. T., engine house foreman, Rutland, Iroquois.
Wagner, O. D., Asst. Supt., Atlantic R. R.
West, Mrs. G. H., D. W. Boiler Inspector, P. R. R.
Watson, J. F., Train Despatcher, Atlantic City.
Watson, J., Penn. Railroad, Speidel Hotel.
Wilson, H. H., Resident Engineer, Boston & Maine, Young's.
Williamson, E. S., Agt. Pullman Co., Atlantic City Railroad.

The Joliet Railway Supply Company, Joliet, Ill., spaces 450-500, in addition to the well known Perry side bearings, is exhibiting the Huntoon brake beam of eight different classes. This is the first time that the Huntoon beam has been shown at a convention and as every feature is new it should be carefully inspected. The company is represented at the convention by H. M. Perry and E. A. Laughlin.

A steel car bolster will be welded for the Standard Oil Company, by the Davis-Bournonville process, in the special booth at the rear of the Greek Temple. Special welding will be done at the request of visitors, and the apparatus explained. Printed matter and complete information can be obtained at the booth of the Commercial Acetylene Co., New York, space 201-209.

Conventionalities

W. C. Arp, of the Vandalia, and Mrs. Arp were among the early arrivals.

According to the *Chicago Daily Tribune*, F. A. Delano has declined the post of Minister to China.

Thomas Madill, the well-known Chicago manager of Sherwin-Williams Company, arrived Tuesday on the Manhattan Limited over the Pennsylvania and is quartered at the Marlborough-Blenheim.

Harry W. Finnell, of the Chicago Railway Equipment Company, will be delayed by business from reaching Atlantic City until Sunday. C. P. Williams, of the same company, will reach the conventions by Saturday.

T. W. Heintzleman, superintendent of motive power of the Southern Pacific, who has not been to a Master Mechanics' convention for 20 years, is attending this year, accompanied by Mrs. Heintzleman.

John Mackenzie, who has been a veteran in both associations long enough to get used to it, is here again. It is now some years since John became accustomed to the other side of the game from that on which he served for so many years.

Mrs. Emily A. Carr, of Oak Park, Ill., mother of Robert F. Carr, president of the Dearborn Drug & Chemical Works, and of George R. Carr, vice-president of the same company, is attending the conventions for the first time. It is also her first visit to Atlantic City.

A rival to the far-famed exhibit of the American Blower Company has appeared in one of the permanent exhibits in Marine Hall on the pier, where twice a day one of the performing seals may be seen balancing a ball on his whiskers. At least, it looks so.

It happens that Thomas is the third treasurer of the Parkesburg Iron Company, but he's also the third Thomas. That is, he's George Thomas, 3rd. And the assistant general manager is a Humpton—not a Huntton; but he says he don't object to hunt'n if the game makes a noise like an order.

E. C. Sawyer, representative of H. G. Hammett, is offering a reward for the return of a trunk and suit case which strayed away somewhere between Richmond and Atlantic City. Mr. Sawyer says their absence reduces him to the minimum three changes of wardrobe—put on, take off, and go without!

The two members of the Berry family on the entertainment committee, B. Berry and C. Berry, went bathing on Wednesday. B. Berry returned to his duties, but C. Berry has not yet shown up, unless, as darkly hinted, he is identical with the person who is now masquerading under the name of J. S. Seabury.

Carl J. Mellin, mechanical engineer of the American Locomotive Company, and designer of all sorts of compound locomotives and things, appeared upon the scene on Tuesday. Confidentially, it may be stated as common report that Carl articulates according to the Mallet system and calculates his expense accounts by means of a Zeuner diagram.

Wherever Moses may have been when the lights went out on the pier and boardwalk on Tuesday evening, it is certain that the electric sign of the *Railroad Age Gazette* appeared in the role of the Moses who led the children of Israel out of the darkness, and in this instance there were a few Gentiles among them. The lights in the sign went on an appreciable period ahead of any others.

H. F. Ewan, agent for the United States Express Company at Atlantic City, has done much to help exhibitors by his tire-

less personal efforts to make prompt deliveries. Work of this kind is characteristic of the United States Express Company. The publishers of the *Railroad Age Gazette* know of no better organization in the transportation industry.

The special trolley cars for the baseball game between the Railway and Supply teams will leave from South Carolina avenue and the Boardwalk on Saturday at 2.30 p. m. Admission to the grounds will be by badge only. The parade will start from the pier at 2 p. m. sharp. Members of the teams are requested to be at the entrance to the pier in uniform at 1.45 p. m.

Harry C. Quest, Chairman of the Transportation Committee, reports a week of success in his department. One hundred and twenty-five chairs were used by convention people Wednesday, and it was found necessary to increase this number to 150 on Thursday in order to make everyone happy. There was not a hitch in the carefully made plans of this committee during the week.

In connection with the informal musicale by convention ladies in the ball room of the Marlboro-Blenheim at 4 p.m. on Friday, the chairman of the entertainment committee, Charles P. Storrs, requests that any ladies who are willing to contribute to this entertainment by vocal or instrumental music or by recitation will leave their names with him at the Marlboro-Blenheim as early as possible.

Lost—Executive Committee badge, No. 2007, the property of George A. Cooper. The finder will be rewarded on returning the badge to Mr. Cooper, who may be found in the office of the Executive Committee, at the left of the entrance on the Million Dollar Pier. Mr. Cooper is especially anxious to recover this badge in order to complete a collection covering years of attendance at these conventions.

Mrs. Clark Fisher, owner of the Eagle Anvil Works (Fisher & Norris), the only business woman exhibiting this year, enjoys some unique distinctions. She was the first woman in America to mould an anvil and superintend charging and pouring of a cupola. She did the latter (in her foundry at Trenton, N. J.) for some two years. Mrs. Fisher is also the only female member of the National Association of Manufacturers.

At evening, when the lights are low,
Though all the Boardwalk is aglow,
The biggest part of all the show
Is Lockwood, talking rapidly.
Ah, many years have passed and went
Since "Hammer-blow" his leave was sent,
And every word since then he's spent
Has been an M. M.'s sepulchre.

Owing to a sense of delicacy on the part of the "Door" Sub-Committee and the Entertainment Committee in going to the same extent as a custom-house officer in the matter of searching, it is requested that members of all associations, and particularly ladies, wear their badges in as conspicuous a position as possible. By heeding this gentle admonition much favor will be conferred upon the committee and all concerned will be benefited.

Calvin S. Parker and Thomas Parker, of the Parker Car Heating Co., Detroit, Mich., and London, Ont., are at the convention and stopping at Younges Hotel.

Former students of the University of Missouri who may be present at the conventions are invited to send their cards and hotel addresses to Prof. H. Wade Hibbard, Hotel Richmond, Kentucky avenue, Atlantic City.

T. M. Gallagher, vice-president of the Scullin-Gallagher Iron and Steel Company, St. Louis, Mo., arrived at the convention yesterday and is stopping at the Marlborough-Blenheim. Mr. Gallagher, who is hailed as "Uncle Tom" by his old friends, has not missed a convention since the beginning.

At the close of the conventions Mrs. Emily A. Carr, Mr. and Mrs. Robert F. Carr and Mr. George R. Carr, of Chicago, will go to New York for a short visit of pleasure. On June 29 they will await the arrival of the Hamburg-American steamship Ryndam and will welcome Miss Irene Carr, who has been studying in Munich during the past ten months. Miss Carr has attended two previous conventions of the M. C. B. and M. M. Associations, once at Manhattan Beach and the first Atlantic City conventions.

F. W. Brazier, superintendent of rolling stock, New York Central, comes alone to the conventions this year. His daughter, Miss Mabel, is in Europe. Mrs. Brazier has gone in another direction. He has done good work for the Master Car Builders, in convention and out, and deserves more than the little rest his multitude of friends will allow him to have here. Flattering offers of a connection with The Daily staff, based on his bringing-up in a printing office in Boston, failed to shake his determination to take it easy.

Did you hear of the burglary performed upon Whipple's trunk? Whipple had a lot of special badges therein, and naturally was careful to keep the trunk locked. President Turner couldn't find certain committee badges when he wanted them. Whipple was not to be found. Turner wanted the badges badly. He suspected they were in Whip's trunk. Got a porter and a cold chisel. Went to Whip's room. Cut off the rivets of the lock. No committee badges. Others. Turner thought. Wouldn't do to leave other badges with trunk unlocked. Put 'em in hotel safe. Whipple returned. No badges. Trunk busted open. Scene in hotel office. Curtain.

A new feature this year in connection with the issuance of badges is the presentation with each badge of neatly engraved cards reading as follows, with only the necessary change of name and date to adapt them to the purposes of the two associations: "The officers of the American Railway Master Mechanics' Association request the honor of your presence and that of your guests at a reception on the evening of Wednesday, the sixteenth of June, one thousand nine hundred and nine, at nine o'clock, in the Marlborough-Blenheim Hotel, Atlantic City, New Jersey." The date of the reception by the officers of the Master Car Builders' Association is June 21.

Atlantic City being so dull just now, a few ladies, to while away the time and not get out of practice, organized a progressive bridge party at the Marlborough-Blenheim, Wednesday afternoon. The party included Mrs. F. H. Scheffer, Mrs. W. H. Miner, Mrs. L. R. Phillips, Mrs. F. A. Ingalls, Mrs. Geo. L. Fowler, Mrs. C. E. Fuller, Mrs. A. Buchanan, Mrs. H. M. Pflager, Mrs. A. Telford, Mrs. A. L. Humphrey, Mrs. R. Carr, Mrs. T. M. Ramsdell, Mrs. W. O. Jacquette, Miss Jean Ingalls, Miss Edna Dunn and Miss J. H. Leyonmarck. The prizes were won, the first by Mrs. Miner, the second by Miss Edna Ingalls and the third by Mrs. Carr.

Many members of the convention probably are not aware that the meetings are being held some 100 feet further from the shore this year than they were last year. In order to provide so much needed additional exhibit space it was decided to move the Greek Temple back to the end of the wide part of the pier and thereby add 100 feet to the length of the pavilion. The Temple was jacked up, put on rollers and run back to its present location, after a few additional piles had been driven to support its outer end. It looks so natural in its new location, that unless one's attention is drawn to the fact, he would not suspect that it had been there only a few weeks.

C. S. Campbell, assistant general superintendent of the United States Express Company at Philadelphia, is spending part of his time at the convention, as is also T. A. Murtagh, agent of the foreign express and freight department.

H. N. Turner, general sales manager of the St. Louis Surfacer & Paint Manufacturing Company, St. Louis, Mo., is attending the convention and stopping at the Chalfonte Hotel.

J. H. Jaschka, of the National Malleable Castings Company, who stole a march on his friends by joining the ranks of the benedicts in April, returned from his wedding trip just in time for the conventions. Jack combined business with pleasure in a trip of some six weeks to the Pacific coast. He left Mrs. Jaschka in Omaha, her former home, while he came to Atlantic City to explain how it happened.

Something seems to have suggested to one of the convention workers, who was trying to do something or somebody, the following lines for which credit is given to the New York Evening Sun:

Scene: Exchange, Marlborough-Blenheim.
Time: June 16, 1909, 10 o'clock p. m.
Enter, George A. Post.
Post (in deep sotto voce, as baritone in balcony begins to rave): "Where is the reception?"
Bystander: "It's all over but the shouting" (meaning the singing).
Post (with a steadily increasing loud pedal): "Well, by ——; I'll have a reception all by my lonesome!"
Woman in Black (to Post): "There's singing going on, sir!"
Post (soft pedal, emergency application): "Yes, madam; you guessed right."
Exits (fireproof)—Woman in Black, with cat-like stealth, sneaks. Post, spying Vaughan, makes a bee-line in that direction and starts his reception.

In that land of happy dreams,
Peaceful, lovely Philippines,
Where the bolo-men are hiking night and day;
Where Tagalos steal and lie,
Where Americanos die,—
There our soldiers chant this happy evening lay.
"D—n, d—n, d—n the Filipinos—
Cross-eyed, Kakiak Ladrones—
Beneath the starry flag
Civilize 'em with a Krag,
And return us to our happy, happy homes."
And beneath the wormy thatch,
Where the skinny chickens scratch,—
Only refuge after hiking all day long;
Where the fleas and bedbugs bite,
Where the puppies whine all night,—
There our soldiers sing this cheerful evening song:
Chorus—

With reference to the annual baseball game, Railway Men versus Supply Men, we may say confidentially to the former that information has been given authoritatively that their opponents have, since February 22, been in hard and diligent training individually for the game, and while they may lack practice in team work because of certain municipal regulations prohibiting the gathering of crowds, they are otherwise fit. The renowned coach, Jack Johnson, who has repeatedly brain-sculled Cornell to victory on the waters of beautiful Cayuga, has been coaching them since his return from Mombasa. Their staff of slab-artists includes the discoverer of the "foi de awaigh." Little is known of this delivery at this time, except that it is of pre-historic origin. The physical qualifications for the team are understood to be most rigid. Copies of the specifications are scarce, but blueprints have been promised and, if promptly received, will be published in a subsequent issue.

The annual report of the Boardwalk, which will not be made public soon, shows most gratifying results as compared with other common carriers. The road occupies a unique strategic position. While its actual mileage owned and operated is small for a trunk line, only six miles, it draws traffic from a whole continent, rich in mineral resources and agriculture. The region immediately served is well built up. The important feeders are the Pennsylvania, the Central of New Jersey and the Net Haul and Brady's Baths spur lines. Although the ruling grades are negligible and the curvature usually easy to negotiate, there has been little attempt to encourage freight traffic. The only freight ever operated on the line was the Scullin-Gallagher flat car, and that went straight across. The passenger mileage amounted to 468,900,000 miles and earnings from this traffic were at the rate of $4.98 per mile. This is exclusive of the earnings of private companies operating roller chairs under trackage rights—these not coming under the jurisdiction of the Interstate Commerce Commission. The greatest traffic density is on the middle division, from the Young's pier to the Steel pier. Figures for maintenance of passenger equipment on this division are understood to be high, but the Marlborough-Blenheim and Chalfonte shops withhold them.

Mister T. Stanley Higgs, the colored gentleman who represents the Chicago Railway Equipment Company in making arrangements for the care of the company's exhibit and in seeing to it that the water cooler is constantly filled with the popular Chalfonte highballs, has become quite a character at the conventions. This is the third year in which he has given the visitors at the booth of his employers a continuous vaudeville entertainment of high class, always bringing into publicity the merits of the product of the Chicago Railway Equipment Company. After several nights spent in earnest thought Mister T. Stanley Higgs has conceived an idea. Having taken several first prizes for cakewalking in this neck of the woods Mister Higgs desires to assemble all the convention hosts some evening, give the best cakewalk for all comers ever held hereabouts and just as the grand prize is about to be awarded to the illustrious Mister Higgs, that gentleman will desert his smiling partner, who has ably assisted him in winning honors, put his arm affectionately around a Creco brake-beam and with it modestly march to the judges stand to receive the first award.

Mr. T. Stanley says: "We are all here for publicity's sake," and he believes he will bring many orders to his company if his plan is carried out. He has merely outlined the affair in the following letter to his employers, but in explaining fully the details he let slip the "main stunt" of the evening as given above.

Atlantic City, June 14, 1909.

Mr. C. H. Williams, Jr.,
Manager Chicago Railway Equipment Co.,
Million Dollar Steel Pier.

Respected Sir:

I write to you for advice towards having a big ball called Car Builders Ball given by T. Stanley Higgs, Jacker Duster (last year Mister Higgs was given the nickname by his employees, of "slack adjuster," and T. Stanley could never make out what it meant). I've been kidding a lot of my acquaintances concerning the ball and asking them to buy tickets for the same and they said they would. As the time is short I would like to push it through as soon as possible and have tickets and programme printed so as to have the ball well established. Of course it will be for the car builders only and will be entertained by the colored orchestra and cakewalkers, all champions. I would like to have you as treasurer as I want you to be the head man, next to myself. Mr. C. P. Williams could be president and Mr. Charles Finnell, secretary. I would like for you to write this up yourself as I think it will be a better success, as you are one of the car builders.

From yours respectfully,

T. STANLEY HIGGS.

LADIES' INTRODUCTION COMMITTEE.

In order that ladies who are in attendance upon the conventions for the first time or whose acquaintance is limited may enjoy to the fullest extent the social and other entertainments provided for them, the Entertainment Committee has made up a list of ladies who will serve as a committee of introduction. Each of the ladies whose name appears upon the list has been sent a silk badge in the form of a pansy, and a card requesting her assistance in helping to further the social spirit that has always been an attractive feature of these conventions, with especial reference to those who are attending for the first time. The list follows:

Mrs. Vaughan, Miss Eugenia McKenna, Miss Kate McKenna, Mrs. Turner, Mrs. Geo. N. Dow, Mrs. W. E. Fowler, Miss Edna Fowler, Miss Ruth Fowler, Mrs. J. F. Walsh, Mrs. E. W. Pratt, Miss Pratt, Mrs. D. C. Noble, Mrs. Wm. Marshall, Mrs. Moran, Mrs. F. W. Brazier, Mrs. F. O. Brazier, Mrs. A. L. Whipple, Mrs. Mark Ross, Mrs. A. P. Storrs, Mrs. S. W. Midgley, Mrs. G. H. Bussing, Mrs. Geo. Molleson, Mrs. W. H. Miner, Mrs. La Bonta, Mrs. J. M. Stayman, Mrs. C. A. Dunkerberg, Mrs. Frank Morrison, Mrs. Weatherly, Miss Walsh, Mrs. Garstang, Miss Mabel Garstang, Miss Virginia Garstang, Miss Moran, Mrs. Geo. N. Riley, Mrs. T. M. Ramsdell, Mrs. John Howard, Mrs. J. E. Meek, Mrs. C. E. Fuller, Mrs. Chas. P. Storrs, Mrs. W. A. Blanchard, Mrs. A. S. Blanchard, Mrs. Geo. Moses, Mrs. Chambers, Mrs. Geo. A. Post, Mrs. Eugene Chamberlin, Mrs. B. P. Flory, Mrs. Younglove, Mrs. R. C. Burnett, Mrs. F. F. Gaines, Mrs. W. B. Leach, Mrs. J. W. Fogg, Mrs. W. C. Arp, Mrs. D. Brown, Mrs. T. H. Curtis, Mrs. A. C. Hinckley, Mrs. John Tonge, Mrs. Harry D. Vought, Mrs. Legrand Parrish, Mrs. L. R. Phillips, Mrs. Chas. W. Wardell, Mrs. C. H. Jenkins, Mrs. Thomas Farmer, Mrs. J. Will Johnson, Mrs. S. G. Allen, Mrs. J. M. Brown, Mrs. Wm. T. Henry, Miss Hayes, Mrs. De Rosset, Mrs. Wm. McIntosh, Miss Ethel McIntosh, Miss Jessie McIntosh, Mrs. Telford, Mrs. H. Montgomery, Mrs. C. M. Walsh, Mrs. G. N. Caleb, Mrs. Geo. Sevey.

PNEUMATICS.

When the blower (while you stare)
Blows the ball up in the air,
  And holds it by pneumatic sleight of hand,
All the other air around
Is converted into sound
  By the Philippines Constabulary Band.

All the noises of the shop,
From the basement to the top,
  Now are heard far out upon Atlantic's strand;
And the black seals' lazy grunts
Are translated into stunts
  By the Philippines Constabulary Band.

(Chorus.)

Tramp, tramp, tramp, upon the Boardwalk,
  Greet all Mechanics as they land;
When they get upon the pier
You will find you are too near
  To the Philippines Constabulary Band.

BADGE NO. 2.—N. B.

The holder of badge-shield No. 2 of the Master Mechanics' Association is requested to return it to Secretary Taylor and exchange it for another number. The number properly belongs to G. W. Wildin, first vice-president, and was given out by mistake.

CASTLE NUTS.*

At the convention last year the dimensions of castle nuts as formulated by the committee were recommended for use during the current year, with a view to adopting them as standard if found satisfactory. The committee was continued to get in touch with the manufacturers of castle nuts and with other parties interested, with a view of establishing them as a regular standard of the association.

Circulars of inquiry were sent to the members of the association, and a number of nut manufacturers. From the replies received the committee has made some few revisions and some correction of errors in the dimensions.

It has prepared Plate No. 4-A to accompany this report as a substitution for Plate No. 4, of last year's report.

1. Last year the committee recommended widths across flats or short diameter of hexagon to be the same as the U. S. standard dimension for finished hexagon nuts, finish to be obtained simply by grinding. This recommendation did not meet with any great favor, and is now modified to show the width across flats same as the rough dimenson for U. S. stand-

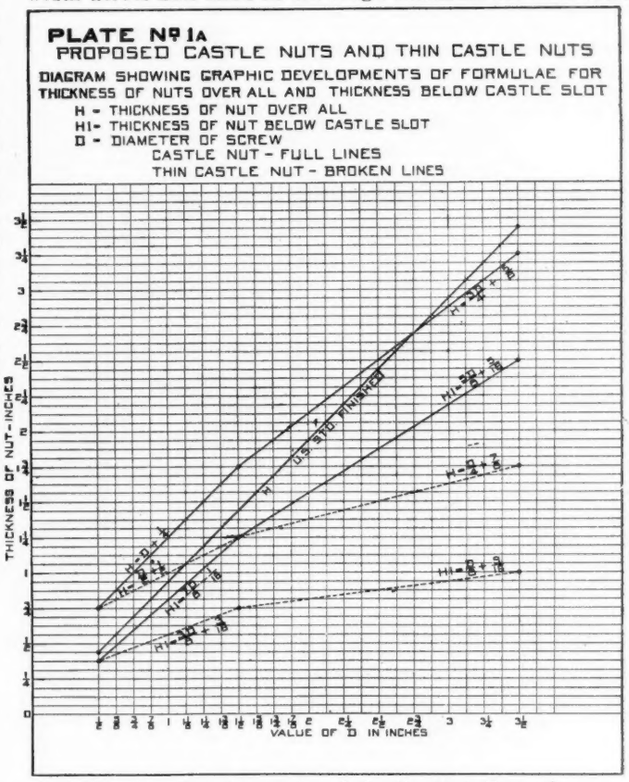


PLATE Nº 1A
PROPOSED CASTLE NUTS AND THIN CASTLE NUTS
DIAGRAM SHOWING GRAPHIC DEVELOPMENTS OF FORMULAE FOR THICKNESS OF NUTS OVER ALL AND THICKNESS BELOW CASTLE SLOT
H = THICKNESS OF NUT OVER ALL
H1 = THICKNESS OF NUT BELOW CASTLE SLOT
D = DIAMETER OF SCREW
CASTLE NUT - FULL LINES
THIN CASTLE NUT - BROKEN LINES
U.S. STD. FINISHED
THICKNESS OF NUT - INCHES
VALUE OF D IN INCHES

Graphic Developments of Castle Nut Formulas.

ard nut, finish to be obtained by grinding or milling, at the option of the user.

2. An error has been corrected in the diameter of facing collar for the ⅝-in. size, making it 1 in. instead of 15-16 in.

3. On account of increase in dimensions of widths across flats the formulæ for length of common cotter pin was corrected to suit, and the lengths recommended for cotter pins have been revised, where necessary, to agree with the nearest manufacturers' standard length to that found by the revised formula. The lengths affected by this change are in the ¾-in., 1¼-in., 1⅜-in., 1½-in., 1¾-in. and 2½-in. sizes.

4. The lengths of taper pins as recommended were found to be too short to conform with good practice, and have therefore been corrected so that now they correspond very nearly with the lengths recommended for common cotter pins. The difference between the taper pin and the cotter lengths were only made necessary to conform with the manufacturers' standard lengths for the sizes of taper pins specified.

5. In increasing the length of taper pins there were several instances where the change necessitated an increase in diameter or size of pin in order to come within the manufacturers' list of sizes. To accommodate this it was necessary to increase the width of slot and corresponding depth for sizes 1⅛ in., 1¼ in., 2½ in., 3 in., 3¼ in. and 3½ in.

*Report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: R. B. Kendig (chairman), J. F. De Voy, H. P. Meredith, J. N. Mowery, G. S. Edmunds.

6. In increasing the width and depth of slot it was necessary to increase several of the sizes of cotters, making them a size larger in the 1⅛-in., 1¼-in. and 2½-in. sizes.

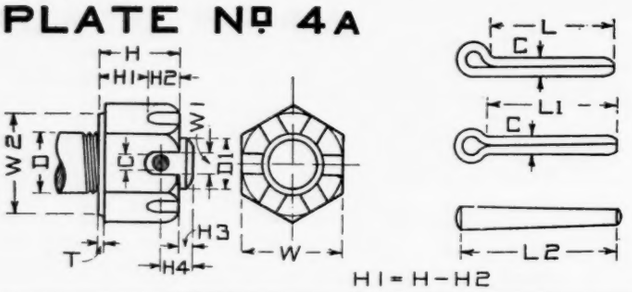
7. Deepening the slot required a revision of the length of reduced end of bolt in the sizes affected by the change in the depth of slot.

8. In order to be consistent with the smaller sizes the distance from center of cotter-pin hole to end of bolt was corrected in the sizes above 1⅞ in.

9. Changing the length of taper pin required changes in the sizes of taper pins in the 1⅛-in., 1¼-in., 1⅜-in., 1½-in., 1⅝-in., 2-in., 2¼-in., 2½-in., 3-in., 3¼-in. and 3½-in. sizes, to agree with manufacturers' standards.

The committee found that the castle nut is being exten-

PLATE Nº 4A



H1 = H − H2

TABLE OF DIMENSIONS FOR CASTLE NUTS AND THIN CASTLE NUTS

DIMENSIONS GIVEN ARE IN INCHES

RECOMMENDED DIMENSIONS

NUT	D	DIAMETER OF SCREW	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2¼	2½	2¾	3	3¼	3½
		NO. OF THREADS PER INCH U S. STANDARD CASTLE AND THIN CASTLE NUT	13	11	10	9	8	7	7	6	6	5½	5	5	4½	4½	4	4	3½	3½	3¼
		NO. OF THREADS PER INCH FOR SPECIAL THIN CASTLE NUT	13	11	10	9	8	8	8	8	8	8	8	8	8	8	8	8	8	6	6
	W	DIAMETER ACROSS FLATS ROUGH SIZE	⅞	1 1/16	1¼	1 7/16	1⅝	1 13/16	2	2 3/16	2 3/8	2 9/16	2¾	2 15/16	3⅛	3½	3⅞	4¼	4⅝	5	5⅜
	W2	DIAMETER OF FACING COLLAR	13/16	1	1 3/16	1⅜	1 9/16	1¾	1 15/16	2⅛	2 5/16	2½	2 11/16	2⅞	3 1/16	3 7/16	3 13/16	4⅜	4 9/16	4 15/16	5 5/16
	T	THICKNESS OF FACING COLLAR	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32	1/32
	H	THICKNESS OF CASTLE NUT-ROUGH	13/16	15/16	1 1/16	1 3/16	1 5/16	1 7/16	1 9/16	1 11/16	1 13/16	1 15/16	2	2⅛	2 3/16	2 3/8	2 9/16	2¾	2 15/16	3⅛	3 5/16
	H	THICKNESS OF CASTLE NUT-FINISHED	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2 3/16	2 3/8	2 9/16	2¾	2 15/16	3⅛	3 5/16
	H	THICKNESS OF THIN CASTLE NUT-ROUGH	13/16	⅞	15/16	1	1 1/16	1⅛	1 3/16	1¼	1 5/16	1⅜	1 7/16	1½	1 5/8	1 11/16	1¾	1 13/16	1⅞	2	2 1/16
	H	THICKNESS OF THIN CASTLE NUT-FINISHED	¾	13/16	⅞	15/16	1	1 1/16	1⅛	1 3/16	1¼	1 5/16	1⅜	1⅜	1 7/16	1½	1 9/16	1⅝	1 11/16	1¾	1 13/16
		NO OF SLOTS IN CASTLE	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	W1	WIDTH OF SLOT IN CASTLE	¼	¼	¼	5/16	5/16	⅜	⅜	⅜	⅜	⅜	7/16	7/16	7/16	7/16	9/16	9/16	5/8	5/8	5/8
	H2	DEPTH OF SLOT IN CASTLE	⅜	⅜	⅜	7/16	7/16	½	½	½	½	½	9/16	9/16	9/16	9/16	11/16	11/16	¾	¾	¾
BOLT	C	DIAMETER OF COTTER PIN HOLE IN BOLT	3/16	3/16	3/16	¼	¼	5/16	5/16	5/16	5/16	5/16	3/8	⅜	⅜	⅜	½	½	½	½	½
	H3	PROJECTION OF BOLT BEYOND TOP OF NUT	3/16	3/16	3/16	3/16	3/16	¼	¼	¼	¼	¼	¼	¼	5/16	5/16	5/16	5/16	⅜	⅜	⅜
	D1	DIAMETER OF REDUCED END OF BOLT	⅜	7/16	9/16	11/16	13/16	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1 7/8	2⅛	2 5/16	2 9/16	2¾	3
	H2+H3	LENGTH OF REDUCED END OF BOLT	9/16	9/16	9/16	5/8	5/8	¾	¾	¾	¾	¾	13/16	13/16	⅞	⅞	1	1	1⅛	1⅛	1⅛
	H4	DISTANCE FROM CENTER OF COTTER PIN HOLE TO END OF BOLT	⅜	⅜	⅜	7/16	7/16	½	½	½	½	½	9/16	9/16	5/8	5/8	11/16	11/16	13/16	13/16	13/16
COTTER	C	NOMINAL DIAMETER OF COTTER PIN	3/16	3/16	3/16	¼	¼	5/16	5/16	5/16	5/16	5/16	⅜	⅜	⅜	⅜	½	½	½	½	½
	L	LENGTH OF PLAYER COTTER PIN	⅞	1	1¼	1½	1½	1¾	1¾	2	2	2	2½	2½	3	3	3½	3½	4	5	5
	L1	LENGTH OF COMMON COTTER PIN	1¼	1½	1¾	2	2	2¼	2½	2½	3	3	3½	3½	3½	4	5	5	5	6	6
TAPER PIN		SIZE OF TAPER PIN USED IN PLACE OF COTTER	#2	#2	#2	#4	#4	#6	#6	#6	#6	#6	#6	#6	#7	#7	#8	#8	#9	#9	#9
	L2	LENGTH OF TAPER PIN	1¼	1¼	1½	1¾	2	2¼	2¼	2½	2¾	3	3¼	3¼	3½	3¾	4¼	4½	5	5¼	5¾

FORMULAE — DIMENSIONS OBTAINED FROM FORMULAE

D	DIAMETER OF SCREW	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2¼	2½	2¾	3	3¼	3½
W=3D/2+1/8	DIAMETER ACROSS FLATS OF ROUGH NUT PLAIN U.S., CASTLE AND THIN CASTLE NUT	⅞	1 1/16	1¼	1 7/16	1⅝	1 13/16	2	2 3/16	2 3/8	2 9/16	2¾	2 15/16	3⅛	3½	3⅞	4¼	4⅝	5	5⅜
H=D+5/16	THICKNESS OF CASTLE NUT ½" TO 1½" DIAM. ROUGH	13/16	15/16	1 1/16	1 3/16	1 5/16	1 7/16	1 9/16	1 11/16	1 13/16	—	—	—	—	—	—	—	—	—	—
H=3D/4+11/16	THICKNESS OF CASTLE NUT 1½" TO 3½" DIAM. ROUGH	—	—	—	—	—	—	—	—	1 13/16	1 29/32	2	2 3/32	2 3/16	2 3/8	2 9/16	2¾	2 15/16	3⅛	3 5/16
H=D+1/4	THICKNESS OF CASTLE NUT ½" TO 1½" DIAM. FINISHED	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	—	—	—	—	—	—	—	—	—	—
H=3D/4+5/8	THICKNESS OF CASTLE NUT 1½" TO 3½" DIAM. FINISHED	—	—	—	—	—	—	—	—	1¾	1 27/32	1 15/16	2 1/32	2⅛	2 5/16	2½	2 11/16	2⅞	3 1/16	3¼
H=D/2+9/16	THICKNESS OF THIN CASTLE NUT ½" TO 1½" DIAM. ROUGH	13/16	⅞	15/16	1	1 1/16	1⅛	1 3/16	1¼	1 5/16	—	—	—	—	—	—	—	—	—	—
H=D/4+15/16	THICKNESS OF THIN CASTLE NUT 1½" TO 3½" DIAM. ROUGH	—	—	—	—	—	—	—	—	1 5/16	1 11/32	1⅜	1 13/32	1 7/16	1½	1 9/16	1⅝	1 11/16	1¾	1 13/16
H=D/2+1/2	THICKNESS OF THIN CASTLE NUT ½" TO 1½" DIAM. FINISHED	¾	13/16	⅞	15/16	1	1 1/16	1⅛	1 3/16	1¼	—	—	—	—	—	—	—	—	—	—
H=D/2+7/8	THICKNESS OF THIN CASTLE NUT 1½" TO 3½" DIAM. FINISHED	—	—	—	—	—	—	—	—	1¼	1 9/32	1 5/16	1 11/32	1⅜	1 7/16	1½	1 9/16	1⅝	1 11/16	1¾
W1=D/8+3/16	WIDTH OF SLOT IN CASTLE	¼	17/64	9/32	19/64	5/16	21/64	11/32	23/64	⅜	25/64	13/32	27/64	7/16	15/32	½	17/32	9/16	19/32	5/8
H2=D/8+5/16	DEPTH OF SLOT IN CASTLE	⅜	25/64	13/32	27/64	7/16	29/64	15/32	31/64	½	33/64	17/32	35/64	9/16	19/32	5/8	21/32	11/16	23/32	¾
C=D/8+1/16	DIAM. OF COTTER PIN AND DIAM. OF HOLE IN BOLT	3/16	13/64	7/32	15/64	¼	17/64	9/32	19/64	5/16	21/64	11/32	23/64	⅜	13/32	7/16	15/32	½	17/32	9/16
L=19D/16+1/4	LENGTH OF PLAYER COTTER PIN	27/32	1	1 9/64	1 19/64	1 7/16	1 37/64	1 47/64	1⅞	2 1/32	2 3/16	2 21/64	2 15/32	2⅝	2 59/64	3 7/32	3 33/64	3 13/16	4 7/64	4 13/32
L1=3D/2+1/2	LENGTH OF COMMON COTTER PIN	1¼	1 7/16	1⅝	1 13/16	2	2 3/16	2⅜	2 9/16	2¾	2 15/16	3⅛	3⅜	3½	3⅞	4¼	4⅝	5	5⅜	5¾

Dimensions for Castle Nuts and Thin Castle Nuts.

sively used on locomotives in all sections of the country. The parts of the locomotive on which the castle is being used include the following: Rod bolts, frame pedestal binder bolts, cross-head pins, cross-head shoe bolts, guide bolts, all valve-motion bolts and pins, brake-connection pins, driving-box wedge bolts, spring-hanger bolts, air-pump bracket bolts, chafing-iron bolts, engine-truck radius bar and radius-bar brace bolts, engine-truck frame bolts, radius-bar carrier bolts, engine truck pedestal bolts, brake-connection pins on tenders, brake-hanger pins, arch-bar and column bolts, and, in fact, on all bolts of the locomotive subject to any motion or wear.

There were reported, however, a number of roads not yet using the castle nuts on account of the excessive cost of manufacture. It is believed by the committee that the adoption of standard dimensions will have a tendency to put the castle nut on a proper manufacturing basis, with the consequent reduction in cost of manufacture. Several railways, on account of the excessive cost, have found it advantageous to equip their forging machines for the manufacture of the castle nut, and from their experience it is evident that the nuts can be thus manufactured at considerably less cost, in the larger sizes at least, than they can now be obtained from the bolt and nut manufacturers.

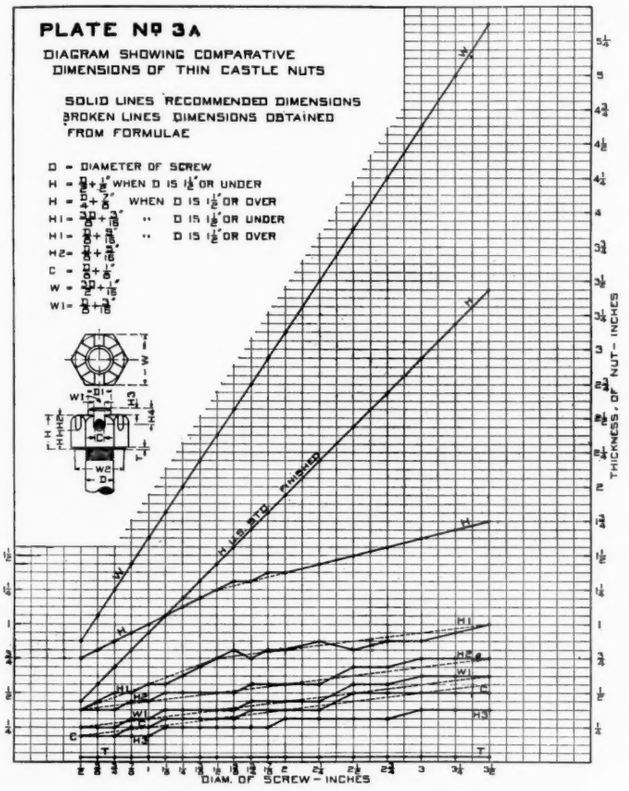


PLATE Nº 3A
DIAGRAM SHOWING COMPARATIVE DIMENSIONS OF THIN CASTLE NUTS
SOLID LINES RECOMMENDED DIMENSIONS
BROKEN LINES DIMENSIONS OBTAINED FROM FORMULAE
D = DIAMETER OF SCREW
H = D + 1/8" WHEN D IS 1 1/2" OR UNDER
H = 7/8 D + 3/8" WHEN D IS 1 1/2" OR OVER
H1 = 7/8 D + 1/8" " D IS 1 1/2" OR UNDER
H1 = 5/8 D + 3/16" " D IS 1 1/2" OR OVER
H2 = 5/8 D + 5/16"
C = 5/8 D + 3/16"
W = 3/4 D + 1/16"
W1 = 5/8 D + 1/16"
H=STD. FINISHED
DIAM. OF SCREW - INCHES
THICKNESS OF NUT - INCHES

Dimensions of Thin Castle Nuts.

Plates Nos. 1, 2 and 3, showing the development of formula, have been reissued, having corrections made in dimensions previously referred to as shown on Plate No. 4-A. The corrected plates which accompany this report bear the numbers 1-A, 2-A, 3-A.

Several users of the castle nuts suggested drilling two cotter holes spaced 90 degrees in the larger bolts, for the reason that on the coarser threads 1/12th turn instead of 1/6th would be decidedly preferable. The committee decided not to make any recommendation on this point, preferring only to consider that feature of the bolt necessary to determine dimensions for the castle nut.

The committee makes the following recommendations, the dimensions for each of which is given in detail on Plate No. 4-A, under the heading "Recommended Dimensions":

1. A series of castle nuts having U. S. standard thread with dimensions as shown.

2. A series of thin castle nuts having U. S. standard thread with dimensions as shown.

3. A series of special thin castle nuts having outward proportion the same as thin castle nuts, but having special number of U. S. threads, as shown.

4. Rough castle nuts to have diameter across the flats as shown. These dimensions correspond with U. S. standard dimensions for hexagon nuts. Finish of flats to be obtained by grinding and buffing, or by milling, the same practice as obtains with the U. S. standard nuts.

5. Finished nuts to have facing washer on bottom with dimensions as shown. Rough nuts to have bottom corner slightly chamfered.

6. A series of standard cotter pins with dimensions as shown.

7. A series of Player cotter pins with dimensions as shown.

8. A series of taper pins with dimensions as shown.

9. Bolt ends projecting beyond the bolt with cotter-pin hole location as shown.

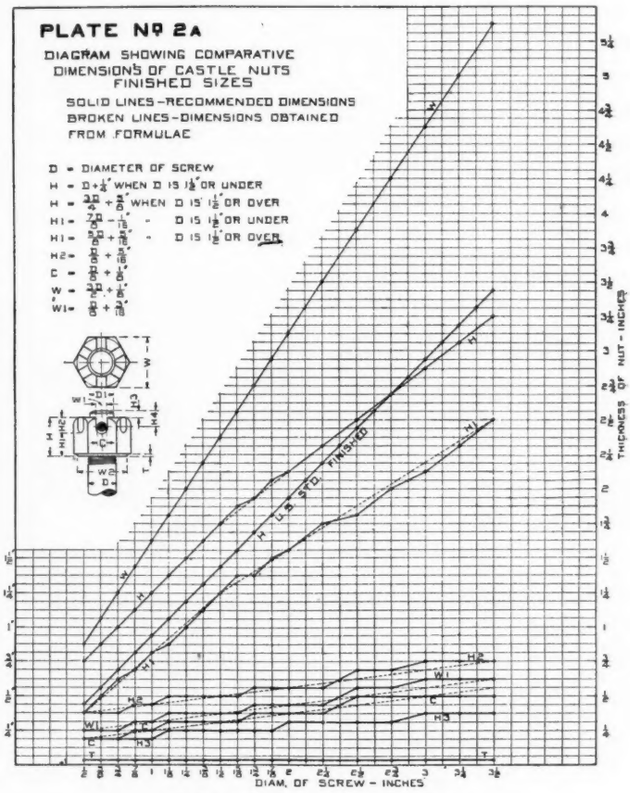


PLATE Nº 2A
DIAGRAM SHOWING COMPARATIVE DIMENSIONS OF CASTLE NUTS FINISHED SIZES
SOLID LINES-RECOMMENDED DIMENSIONS
BROKEN LINES-DIMENSIONS OBTAINED FROM FORMULAE
D = DIAMETER OF SCREW
H = D + 1/8" WHEN D IS 1 1/2" OR UNDER
H = 7/8 D + 3/8" WHEN D IS 1 1/2" OR OVER
H1 = 7/8 D - 1/16" " D IS 1 1/2" OR UNDER
H1 = 5/8 D + 3/16" " D IS 1 1/2" OR OVER
H2 = 5/8 D + 5/16"
C = 5/8 D + 3/16"
W = 3/4 D + 1/16"
W1 = 5/8 D + 1/16"
H = 1.5 STD. FINISHED
DIAM. OF SCREW - INCHES
THICKNESS OF NUT - INCHES

Finished Sizes of Castle Nuts.

John Player and W. L. Austin did not approve of certain details contained in the report, therefore their names are not appended to the report.

WIDENING GAGE OF TRACK.*

The committee was appointed to co-operate with a committee of the American Railway Engineering and Maintenance of Way Association on the subject of widening gage of track at curves. At the 1908 convention of the Master Car Builders' Association it was suggested by this committee that, because some of the M. C. B. standards of the association were under consideration, it would be consistent for that association to be represented in the joint committee, and as a result the Wheel Committee of that association was designated to co-operate with the joint committee.

Some errors were found in the M. C. B. standards illustrated on their drawings of standards, Sheet M. C. B. 12, and these errors have been, or will be, corrected.

The question of widening gage track at curves brings in, necessarily, the question of the width of flange-way at guard rails and frogs, and it is important to record that at the 1909 convention of the Maintenance of Way Association the 1¾-inch width of flange-way was adopted as standard. The same association took action to the effect that the gage of track should be corrected when, due to worn rail head or heads, the gage has been increased ½ inch beyond the standard gage.

If the flange-way at frogs and guard rails is not increased where the gage is increased, then it may not be desirable to increase the gage. However, this is being given further con-

*Report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: F. M. Whyte, F. C. Cleaver, W. H. Lewis.

sideration, and the committee of the Maintenance of Way Association will send to members of that association a circular of inquiry, with the object of ascertaining the practice of the various railways in regard to widening of gage on curves, and it is hoped that the replies may indicate some solution of the problem.

It is suggested that the Master Mechanics' Association continue a representation in the joint committee.

Superheaters.*

On account of the depression in business during the past year, practical demonstrations of the different systems have not reached that point where sufficient information of definite value can be obtained to warrant the committee making further report at this time.

It is encouraging for the future of superheating on American railways to see the interest taken in the subject, and the committee believes that with the advent of better times on the railways there will be considerable development work done along this line. It does not believe it advisable to go into the merits of the various makes of superheaters until such time as the theories are put into actual practice.

Size and Capacity of Safety Valves for Use on Locomotive Boilers.†

The committee was appointed to collect data on the size and capacity of safety valves for locomotive boilers, and to suggest a method for carrying out tests to determine the data in connection therewith.

Owing to financial conditions of the past year, it did not feel justified in asking the railway companies to spend any money in experimental work. The committee has therefore not completed the line of investigation mapped out, and suggests that the committee be continued to complete the work.

PURDUE RAILROAD ASSOCIATION.

A circular letter issued recently to members of the Purdue Railroad Association, which is made up of members of the faculty and students of Purdue University attending the conventions, announced that the annual dinner would be held Saturday evening, June 19, at a place to be announced later. All men at the conventions who have ever attended Purdue are requested to register with F. E. Lister, Purdue '07, at the office of the daily *Railroad Age Gazette*. The register will be on Mr. Lister's desk, where the men can find it in case he is absent. The committee on the dinner are J. L. Conners, F. B. Ernst and F. E. Lister.

CORNELL DINNER.

The annual dinner of the Cornell men attending the convention will be held at the Hotel Chelsea on Saturday evening at 7.30. Director Smith, of Sibley College, will be present again this year and speak about the recent changes and other features of interest in connection with the work of the college. Others hope to speak if it is possible to interrupt the flow of song and story long enough to allow it.

All Cornell men attending the convention or in Atlantic City are requested to register at the booth of the *American Engineer & Railroad Journal* opposite the west stairway in the main building.

David J. Champion, vice-president and general manager of the Champion Rivet Company, of Cleveland, accompanied by W. H. S. Bateman, general eastern and southern sales agent of the company, with headquarters in Philadelphia, arrived at Atlantic City Wednesday. Mr. Champion has almost completely recovered from a recent severe illness and his many friends visiting the conventions will greet him with pleasure.

*Report presented at the annual convention of the American Railway Master Mechanics' Association. Committee: Le Grand Parish (chairman), R. D. Hawkins, Grant Hall, W. F. Buck, C. A. Seley.

†Report presented at the annual convention of the American Railway Master Mechanics' Association: Committee: F. M. Gilbert (chairman), James Milliken, W. D. Robb, M. H. Wickhorst, J. G. Neuffer.

THE PHILIPPINES CONSTABULARY BAND.

There is much more history connected with the Philippines Constabulary Band, which is playing morning, afternoon and evenings at the conventions, than appears upon the surface. It is the general impression that it plays remarkably good music and we know its members are Filipinos; little more is known to the average individual. Through the courtesy of George C. Sellner, who combines the editorship of the Manila *Times* with the management and press agency of the band, we are enabled to give some facts that may be of considerable interest to convention attendants.

The band was first organized in 1902. At the time Judge Taft assumed the office of Governor-General of Manila, Captain Loving, who is the leader of the band, was authorized to organize a chorus of 500 voices to welcome his arrival. Captain Loving was at that time a lieutenant in a colored regiment. He is 33 years old, a native of St. Paul, Minn., and a graduate of the St. Paul high school and Boston Conservatory of Music. Like all of his race, he is a natural musician and his task was rendered somewhat easier on account of this natural love of music among his pupils, but the material upon which he had to work was the average Filipino material and made up of members of the various tribes, speaking different languages and knowing nothing of written music. However, his success was so great during the year or so after the organization of the chorus that President (then Governor) Taft suggested the organization of a band, of which he should be the leader. Captain Loving entered into the task with untiring activity and the present band of 84 pieces represents the result of less than seven years' work.

The present tour of the band may be considered in the nature of an educational tour and has received the hearty approval of President Taft, who desires to show the people of the United States what the Filipinos really are. The greater part of the acquaintance of United States people with Filipinos is confined to seeing the Igorrot eat dog for his and their delectation at ten cents per throw, but this Igorrot is said to be no more a representative of the Filipino than the painted Indian is a representative of the civilization of America.

Since the organization of the band there have been but few changes in its make-up. Nearly all of the members play several instruments in addition to the one upon which they may be considered as specialists. They are the pride of Manila, and the question of whether for economic reasons their numbers should be reduced by half rose to the dignity of a provincial issue and was taken up with great seriousness by the press of the city of Manila.

They arrived in San Francisco on February 15, and if their tour throughout the United States is continued sufficiently long and the band is as favorably received as it has been at Atlantic City, it is safe to say that the ambition of President Taft to change the views of the American people with reference to what the Filipino really is will have been realized.

M. T. Spicer, the right-hand man of President George W. Stevens, of the Chesapeake & Ohio, is making his first visit to the conventions, accompanied by Mrs. Spicer. President Stevens himself has been the guest of the conventions on several occasions and his courtesies extended on the occasions when the meetings were held at Old Point Comfort are still fresh in the memory of all old-timers. It seems quite possible that in encouraging the visit of Mr. Spicer, Mr. Stevens has a notion of making his right-hand man ambidextrous.

On Wednesday The Daily expressed its regrets that H. S. Demarest, of Greene, Tweed & Co., was in Europe, and therefore unable to attend the conventions. It is now announced that he has returned and will be in Atlantic City before the conventions are over. His trip included various points in England, France and Germany.

Exhibitors and Others

In order to meet the demands of heavier equipment, the Keystone Drop Forge Works, Chester, Pa., is now making 1⅛-in. and 1¼-in. sizes Keystone connecting links. Samples are shown at its space, No. 375. Don't fail to see them.

* * *

The Atha Steel Casting Co., Newark, N. J., is represented at the convention this year by George T. Paraschos, Charles W. Owston, Jr., Louis M. Atha, A. S. Blanchard and Louis A. Shepard. It is exhibiting cast steel body and truck bolsters and manganese steel gears and pinions in spaces 534, 535, 536 and 537. The works of the company have been in operation continously during the eighteen months of business depression, and will continue operations at the old stand. Many improvements have been made during the past year which enable the company to care for customers in a much more satisfactory manner. Its aim is to co-operate with customers at all times, giving the quickest service and best material and workmanship that it is possible to obtain. Personal attention to individual orders is one of the secrets of the service.

* * *

The Chicago Railway Equipment Co. has again excelled itself in making its exhibit more attractive than in previous years. The large exhibit space, Nos. 546 to 551 inclusive, has been arranged to display admirably the products of the company, the combination of green and gold in the decorations being most pleasing. The arrangement includes the well-known Creco, Diamond, National, Hollow, Reliance, Monarch and Sterlingworth beams displayed on racks at the ends of the space, while the various capacities of Monitor bolsters are arranged at the sides. Silk pennants, bearing the well-known "Creco" trade mark, are used in decorating the exhibit, and flowers and ferns add to the display.

* * *

The American Nut & Bolt Fastener Co., Pittsburgh, Pa., uses for Bartley fasteners only steel made from its own specification, of the best low carbon open hearth steel that can be made, and all of its products are perfect mechanically. It has in its employ the best mechanical skill that can be procured.

* * *

The Joseph Dixon Crucible Co., Jersey City, N. J., in advocating its silica-graphite paint as a protective covering for steel cars, is urging the value of the two pigments, silica and graphite, as supplementing each other, in that the graphite gives a very desirable smoothness under the brush, while the silica, with its tooth, adds the necessary body and thickness of film to give long life to itself and happiness to the car builder.

* * *

There is seen in the offices of a majority of the mechanical officials of the railways a calendar which contains information as to the dates of meetings and conventions of railway clubs and associations. This is published by the Storrs Mica Co., Owego, N. Y., as an advertisement of its headlight chimneys. Anyone who does not receive a copy each quarter may arrange to do so by leaving address at this company's space, No. 23, Entrance Hall, on the Pier.

* * *

Mica chimneys are now used by a number of roads on long-time burning switch and signal lamps. These small chimneys are so close to the flame of the wick that the heat resisting properties of the mica make it a most suitable material for their manufacture. These are made by the Storrs Mica Co., Owego, N. Y., and samples may be seen at Space No. 23 on the Pier.

* * *

The many railway friends of Fred Ebert will miss him from this convention. He died suddenly of Bright's disease at his home in La Grange, Ill., May 22. For many years Mr. Ebert had represented the Chicago branch of the Garlock Packing Co., Palmyra, N. Y., at M. M. and M. C. B. conventions, and always took an active part in the social as well as the business features of the conventions. J. P. Landreth is representing Garlock's Chicago branch at this convention.

* * *

"It beats the Devil." This is not a mere repetition of a remark often heard in The Daily office—that would be common-place—but is the announcement on a little red card passed around by the Asbestos Protected Metal Company, space 353. If the claims of the manufacturer of asbestos metal can be substantiated as doubtless they can, it might be well for certain persons who shall be now and forever more nameless to leave an order for a suit of armor before leaving "our city," Remember the name and place, please.

* * *

The Kennicott Water Softener Company, Chicago, is represented at the convention this year by its general manager, Cass L. Kennicott, and by T. G. Windes. The last named gentleman was until recently chemist for the Vandalia Railroad at Terre Haute, Ind., but is now with the Kennicott Company.

* * *

The Galena-Signal Oil Co., Franklin, Pa., is this year holding forth in an attractive reception booth, space 32, where they will be pleased to welcome all members of the Master Mechanics and Master Car Builders Associations, the ladies and friends. The company will be well and ably represented by a number of their salesmen and mechanical experts, and by S. A. Megeath, First Vice-President and General Manager; J. French Miller, Secretary; E. V. Sedgwick, Manager, Mechanical Expert Department, and Harry Hillyer, Secretary, Mechanical Expert Department.

* * *

The Buffalo Brake Beam Company, New York, is exhibiting its brake beams this year at booth 436, right next to Capt. Young's house. Messrs. Crone, Strassburger, Fraser and Barrett are in attendance.

* * *

The Asbestos Protected Metal Co., Canton, Mass., in space 353, is exhibiting the Robertson standard box car roof, which was received with such favor at last year's convention. A large number of the Company's officers and salesmen are attending the convention, and outsiders are receiving prompt attention and a practical demonstration of the company's supplies.

* * *

At the exhibit of the Hunt-Spiller Manufacturing Corporation, Boston, Mass., space 469, in the annex, may be seen a book containing pictures Mr. Leach has taken of persons in attendance at some of the recent conventions and which are very interesting. An invitation is extended to all to look it over. Mr. Leach is also exhibiting, with some pride, a blue ribbon which is a first prize awarded to one of the company's horses by the Boston Work Horse Parade Association, May 31, 1909. From the picture of the horse, it would seem the judges made no mistake.

* * *

H. J. Bellman, who is now manager of the hair felt department of the H. W. Johns-Manville Company, has been unable to get down to the convention because of pressure of business in New York; but his famous model refrigerator car is in evidence in the exhibit of the H. W. Johns-Manville Company.

DUDGEON HYDRAULIC JACKS.

Richard Dudgeon, New York, in spaces 532-3, shows 18 types of jacks and pumps. Among these is an electrically driven pump for use in connection with presses and jacks. This pump, as do all the Dudgeon pumps and jacks, has the universal system of valves, employing three valves only. A special feature is that the valves are located in a separate

chamber near the work, so that the operator can have control of the pressure, without requiring any changes of the pump speed. This result is effected without the addition of pressure valves. The three valves permit three different speeds.

A new type of car inspector's jack, in which the head, ram and pump are in one piece, is also exhibited. This jack has a double pump and is said to be the only car inspector's jack so made. This arrangement is important where speed is necessary. This jack may be lowered either by the valve handle or the lever.

This exhibit also includes two new types of claw jacks, in which the claws are set in contact with the ground, giving a much lower lift than is usually obtained.

SUPPLYMEN'S BADGE.

The badges provided this year for the members and guests of the Railway Supply Manufacturers' Association are much neater and more attractive than for some years past. The accompanying cut represents a full-size badge. In the original

the shield is red and embossed, the number is in blue and the background is gold. The ladies' badges are exact duplicates, except that the shield in the center is white.

GOULD PIN TYPE COUPLER.

This coupler is designed to meet all the requirements where the pin type of coupler is preferred. The pin lock is large and heavy to prevent creeping. A lock set is placed in the bottom of the lock pin, and engages a seat at the top of the side wall to lock-set. To unset the knuckle end strikes the lock-set, unseating it, and the lock then resets on the lock-set on the tail of the knuckle. The lock-set is held out of action when coupler acts by impact or automatically. When uncoupling, a continued lifting of the lock pin after disengagement with the knuckle, operates the knuckle opener, opening the knuckle to its extreme movement.

This coupler meets the requirements of those who object to springs being used, but it has been found from experience that springs are reliable, providing they are of sufficient length, to obviate being strained to, or near, their elastic limit. Where long springs are used under limited compression their life is indefinite and the liability to breakage is minimum. The pin type of coupler can be made with the various types of shanks and butt ends, similar to those used with the No. 950 type, made by the Gould Coupler Company, Depew, N. Y.

STEEL CAR SEATS AND INTERIOR FINISH.

The unique exhibit of the Hale & Kilburn Manufacturing Company, Philadelphia, Pa., located near Convention Hall, presents an attraction which speaks more forcibly than words of the progress of the art of steel car construction. As is well known, this firm has for several years been prominent in the development of steel equipment in the line of car seats, seat doors and sash, but a full-size section of a standard day coach, showing complete interior finish, is now shown for the first time and is attracting marked attention. This car represents material taken from one of the 100 coaches now building for the Harriman Lines, and is set up in full size with operating double windows, curtains, basket rack, etc., as made complete at the Philadelphia factory and shipped to the car builder, ready for erection, giving large savings.

The fact that this class of steel work can be manufactured and supplied to a railway company at a very moderate cost, to be set up in refitting car interiors, opens a new line of business in genuine fireproof car interiors.

The new steel Walkover car seats for the Pennsylvania, Southern, Missouri Pacific, Illinois Central, New Haven, Long Island and other lines are shown, and each has some special claim to merit and originality. The articles shown in this booth are represented at the company's offices in Philadelphia, New York, Chicago, Washington and elsewhere.

ADLAKE-SMALL TRAIN INDICATING LAMP.

The Adams & Westlake Company, Chicago, is showing in its exhibit booth, No. 401, the new Adlake-Small train indicating lamp, which is designed for carrying train numbers, both regular and special, for day and night indications, rendering them easily read and thereby avoiding confusion or error.

The locomotive lamp is placed on the side of the boiler back of the headlight, and in a position where the numbers

Train Indicating Lamp.

are not dimmed by the light from the headlight. The lamp is placed at an angle so that the numbers are easily read by approaching as well as passing trains. Furthermore, this lamp is adaptable to caboose as well as other cars, so that similar signals may be carried at the rear as well as the front end of the train. The illumination of all of the figures is of uniform intensity, and as they are of ample size they are easily read both by day as well as by night.

These lamps have been adopted as standard by some of the most prominent railways and the comments concerning the results are extremely satisfactory as there is no occasion for an improper identification of trains.

BETTENDORF BEARS.

At Booth No. 200, the Bettendorf Axle Company, Davenport, Iowa, is distributing their new catalogue, another story by Bruce Crandall, about the Bettendorf Bears. This booklet tells in verse of the dismantling and assembling of the Bettendorf truck by "Bill and Joe" the Bettendorf Bears, who lightened the troubles, and the cares of the S. M. P. of the P. D. Q. The first booklet telling the story of the Bettendorf Bears met with such a pleasant reception that its author prepared this second story.

In the first story of the Bettendorf Bears is pictured a

brief history of the Bettendorf Bears in connection with the animal line. The shop where nothing is spent on truck repairs is shown in one picture and in another the Bettendorf truck which these bears unanimously favor. Still another picture shows the bears inspecting the truck under an all-

Bettendorf Bears.

steel box car of recent design built at Bettendorf. The last picture in this clever booklet shows the bears engaged in a game of base-ball. It is so illustrated, because the bears on the Animal Line finish their work at noon having no truck repairs to do.

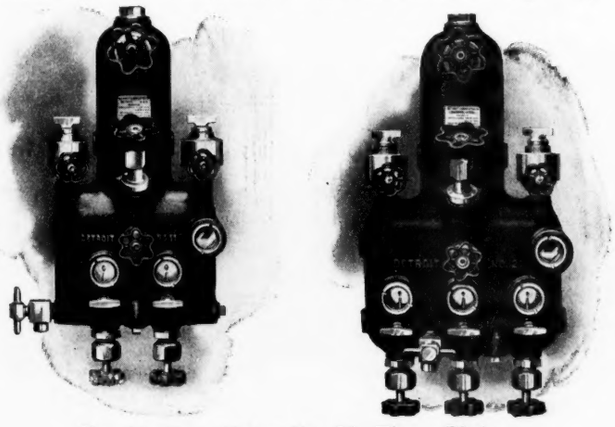
This second booklet gives another reason why the Animal Line uses the Bettendorf truck because it proves conclusively that with this truck it takes only 17 minutes to change wheels.

DETROIT AIR PUMP LUBRICATOR.

The Detroit air pump lubricator should be employed in all cases where the locomotive lubricator proper does not supply oil to the steam cylinder of the air pump. It is of half-pint capacity, a single connection type and can be very easily attached to the steam pipe leading to the air pump. It has a gauge glass to show the amount of oil and the feed regulation is finely graded to allow a very slow feed of oil when desired. It is also well adapted for use on portable engines, steam pumps or other steam cylinders where the use of a single connection lubricator is desirable. The Detroit Lubricator Company, Detroit, Mich., is exhibiting in spaces 379-81.

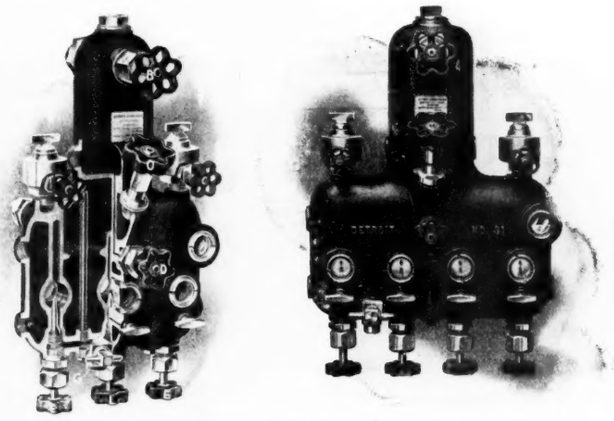
DETROIT BULLSEYE LOCOMOTIVE LUBRICATORS.

The illustrations herewith show different sizes of Detroit bullseye locomotive lubricators, having capacities of two, three,



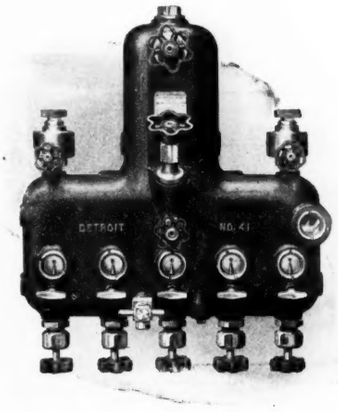
No. 11, Two Pints; No. 21, Three Pints.

four, five and eight pints of oil respectively. The No. 11 lubricator is intended for use on medium size simple locomotives. Each feed delivers oil to one of the steam cylinders. An independent lubricator is usually employed to supply oil to the air pump on locomotives using this No. 11 size.



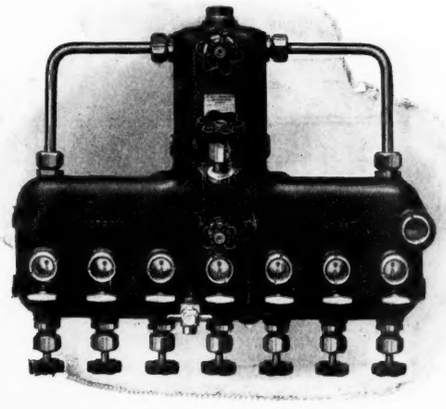
Sectional View; No. 31, Four Pints.

In the No. 21 lubricator, having three feeds, the two outer ones supply oil to the cylinders and the middle feed to the



No. 41, Five Pints.

air pump. No. 31 lubricator is for use on locomotives having two air pumps. The four feeds provide one each for the cylinders and the air pumps. This size can also be used on compound or superheater locomotives, when the feeds are



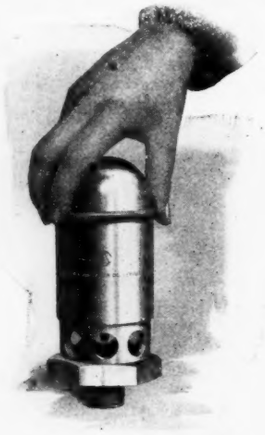
No. 61, Eight Pints.

used for the steam cylinders only, and an independent lubricator for the air pump. No. 41 size is especially adapted for

use with superheater, compound or Mallet locomotives. Four feeds are used for the valve and cylinder lubrication, and the 51 for the air pump. No. 61 size is especially adapted for superheater locomotives, where it is desired to introduce the oil at both ends of the piston valve or for any service requiring seven feeds. On locomotives having extension piston rods, two feeds may be used for oiling these glands. Automatic steam chest plugs are furnished with these lubricators, and the air pump feeds are choked at the lubricator. Detroit Lubricator Company, Detroit, Mich., makers of these lubricators, are exhibiting in booths Nos. 379-81.

DETROIT ROD AND GUIDE CUPS.

These are substantial, well-made oilers. The regulating arrangement in each is entirely independent of the cap, so that either cup may be filled without interfering with the feed.

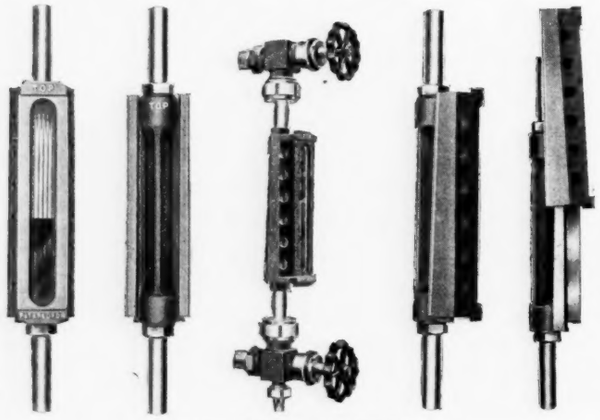


Sight Feed Guide Cup.

The protecting shield of the guide cup is shown slightly raised, in order to expose to view the sight feed feature to show the principle of operation. The Detroit Lubricator Company, Detroit, Mich., is located in booths 379-81.

BOLTLESS REFLEX WATER GAGE.

The Boltless Reflex Water Gage is meeting with success, as it has had much to do with reducing broken glasses to a minimum. The round openings as shown on front slide are placed for the purpose of determining all leakage which might appear on the body.



Boltless Reflex Water Gage.

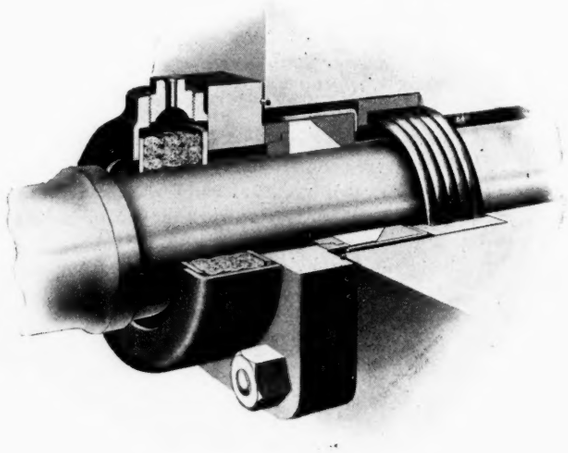
Should any leakage occur, it is but necessary to tap, with a soft hammer, on top of the front slide, which is held in place to the body on the incline plane or wedge principle.

Tests are said to have proved conclusively that breakage of glass does not occur by making tight joint with this principle. The removal of glass is accomplished by tapping the bottom part of the front slide lightly. The gauge will accommodate all makes of glasses. This gage is made by the L. J. Bordo Company, Philadelphia, Pa.

UNITED STATES METALLIC PACKING.

The improved form of United States metallic packing for locomotive piston rods and valve stems using the King patent ring is shown in the accompanying illustration.

This packing is claimed to be much simpler than any now in satisfactory operation on the railways. There are few parts, there is only one ground joint, and there is more room for vibration in the stuffing box. The ring itself is in two



United States Metallic Packing.

parts only, which lock themselves on the rod and are consequently very easy of application.

This form of packing has been severely tested in hard service on a number of roads with marked success.

The great advantages of simplicity and few parts will be clear to railway mechanical men, and these features, coupled with its being steam-tight and giving good mileage, should make this packing an interesting proposition.

It is made by the United States Metallic Packing Co., Philadelphia, Pa.

RYERSON INTERNAL COMBUSTION RIVETER.

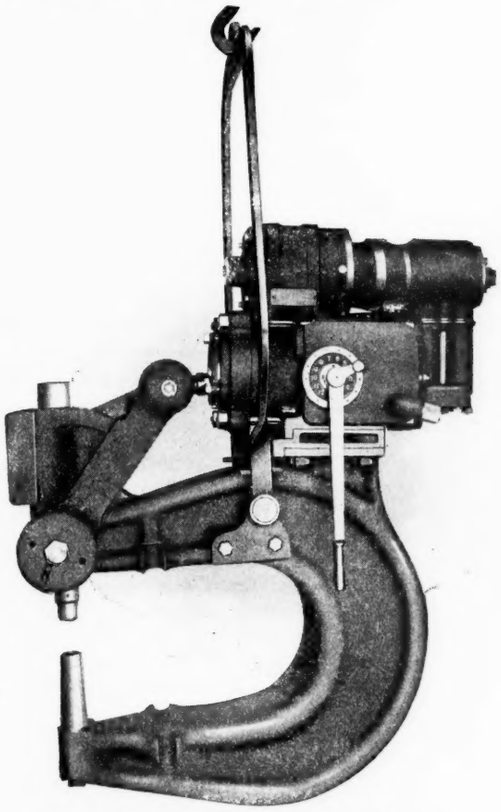
The Ryerson internal combustion riveter made by Joseph S. Ryerson & Son, Chicago, resembles in general appearance the ordinary air machine, but in place of the air cylinder there is mounted on the yoke of the machine a complete and self-contained power plant.

This power plant consists mainly of a cylinder and a piston working therein, the piston being connected by means of the ordinary toggle mechanism direct to the head die. A small electric motor is mounted on the cylinder, the armature shaft being direct connected to a small carbureting pump. When the operator desires to set a rivet, the lever shown is thrown in one direction, thereby closing the motor switch and starting the motor. This operates the pump and pumps a carbureted charge of gasolene and air into the cylinder. This impels the piston forward about one-fourth of its working stroke, causing the head die to descend. As soon as the head die has descended far enough to come in contact with the rivet the motion of the piston is arrested. This causes the pressure in the cylinder to rise, and operates a small automatic plunger, which cuts out the motor switch and at the same time operates the igniter, exploding the charge in the

cylinder, thereby forcing the piston the balance of its working stroke, and setting the rivet. The operator then reverses the lever, thus opening the exhaust valve, exhausting the burned gases in the cylinder and permitting the piston to return to its original position. The return of the piston is automatically accomplished by means of a coiled spring in the hub of the toggle links.

This entire operation requires about one second. In heavy work, when it is necessary to hold the dies on the rivet for any period, this can be done by simply waiting the desired time before reversing the lever to open the exhaust valve.

The Ryerson internal riveter is claimed not only to effect a saving in time, but to reduce the cost of operation to about one twentieth of that of an air machine. It does away with the necessity of installing a compressor, air receiver, air hose, etc., eliminates the cost of the attendants for same, and practically does away with maintenance expense.



Ryerson Internal Combustion Riveter.

The machine is self-contained—all that is required for its operation being a connection to any available electric circuit.

The fact that the motor is in operation only when setting a rivet reduces the consumption of current to a minimum and makes it possible to set a dozen rivets as cheaply per rivet as a thousand.

The machine is always ready for use and uniformity of riveting is assured, as each machine is operated independently and is not subject to a drop in line pressure, as is the case with air machines.

The fact that the moving parts of the machine are at rest at all times except at the instant of the operation of setting each rivet insures minimum wear and prolongs the life of the working parts of the machine. This, of course, is not the case with either air or hydraulic machines, as the power plants of such tools are in constant operation.

The machine is operated by a single lever, the same as an air machine; it is portable, and can be operated in any position. It is extremely simple, both in construction and operation, and the upsetting action is so much quicker than that of any other machine that rivets are driven practically at their full heat, and tighter rivets are the result.

Moreover, the necessity of uniform heating of rivets is done away with, as the operator has absolute control of the pressure and may vary it to suit the heat of each rivet. This is accomplished by means of the small lever shown on the dial. A movement of this lever varies a spring tension against the small automatic plunger, which is operated by the rise in pressure in the cylinder after the head die has come in contact with the rivet, as referred to above. The operator can thus cause the small plunger to be operated at any predetermined pressure as set on the dial. Increasing or decreasing this spring tension increases or decreases the volume of the mixture admitted to the cylinder, thus varying the pressure applied to the rivet.

This machine will drive any size rivet. It requires approximately one gallon of gasolene for 4,000 ¾-in. rivets. The makers will submit prices on any style or capacity of machine desired; they ask that when writing for prices the current available be mentioned.

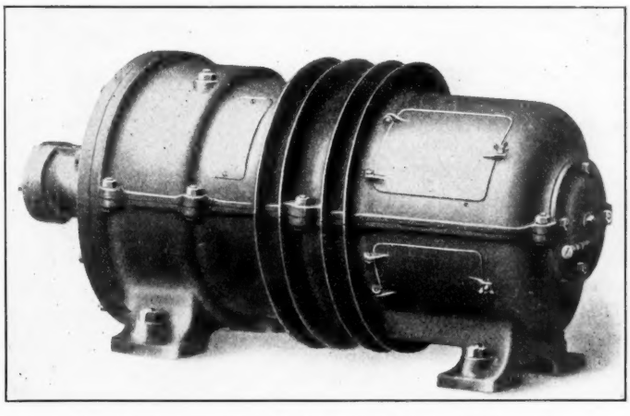
The economical application of power in this riveter is due to the fact that each machine is a self-contained power plant, the pressure being generated within the cylinder of the machine and applied directly to the work performing member, thus eliminating the heavy transmission losses which are suffered in air, steam and hydraulic machines.

This principle has a very wide application and has been worked out successfully in such machines as fixed and portable riveters, punch presses, shears, bulldozers and like machines which have heretofore been operated by steam compressed air, hydraulically, or by means of belt or motor drive.

In all cases it effects a great saving in the expense of operation, maintenance and original cost of plant required. As the capacity of an internal combustion power plant is only dependent upon the bore and stroke of the cylinder, it is a simple matter to design for machines of this type a power plant of any desired capacity. These internal combustion power plants can be operated by gas, where it is found to be available and more economical than liquid fuel.

WESTINGHOUSE HEADLIGHT TURBINE-GENERATOR SET.

Designed with a special view to the simplicity of operation and ruggedness of construction required in electrical apparatus to be placed in charge of men untrained in its super-



Westinghouse Headlight Turbine-Generator Set.

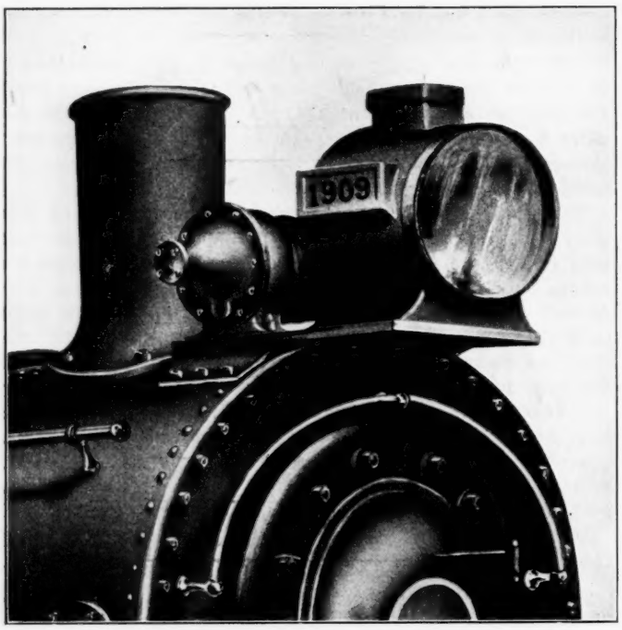
vision, the new Westinghouse headlight turbine-generator set approaches almost the ideal of small power-plant operation, since the engineman has little else to do than open the steam valve, depending on the qualities of the machine for successful continuous operation without further attention.

This outfit, illustrated in the accompanying cuts, is being

exhibited for the first time at the Atlantic City conventions. It is a compact combination of steam and electrical elements of minimum size and weight, and is especially enclosed, so as to be weather proof, for mounting on the locomotive boiler shell. One of the illustrations shows the turbine-generator set (which measures only 25 in. over all, shaft length, and 13 in. in diameter) mounted on the locomotive directly behind the headlight, an arrangement which groups all the parts of the headlight system closely and out of the way.

The steam element, or turbine, is of the impulse type, employing a re-entrant path for the steam, which undergoes almost its total expansion directly at the nozzles. A shaft governor of special design controls directly a throttling valve in the steam admission line.

The generator element is rated at three-fourths of a kilowatt, supplying 25 amperes at 30 volts. It is of the two-pole type, and its high rotative speed makes possible a design of



Westinghouse Headlight Set.

the least size and weight of electrical parts. The entire rotating element is carried on ball bearings, and all parts of the train-lighting outfit are amply protected against injury from moisture or weather conditions. Standard headlamps complete will be furnished, or the arc mechanism may be arranged for insertion in any headlamp case which has been used for oil or other illuminant.

CYCLONE CHAIN HOIST.

The Chisholm & Moore Manufacturing Co., Cleveland, Ohio, is exhibiting in booth 45 a 30-ton hand power chain hoist. This is said to be the largest ever carried in stock, those of equal or greater capacity heretofore made being only specially built to order.

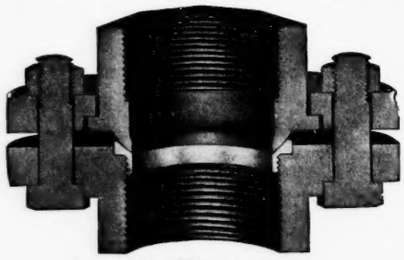
The drive is through roller bearing eccentrics of design similar to smaller sizes of Cyclone hoists, except that three instead of two eccentrics are used. The bearings have self-lubricating, graphite, bronze bushings.

When there is no load the hand wheel may be spun in either direction. When the hand chain is released, the automatic brake immediately locks the block, safely holding the load at any point. It may be lowered by a reverse pull on the hand chain. These features apply to all Cyclone hoists. The 30-ton size is similar, except that the hoist has two idler sheaves and the load is carried by six strands of ¾-in. chain.

The efficiency of the 30-ton hoist is given as 75 per cent. The gear ratio according to shop test, is 504 to 1, 160 lbs. on the chain raising the 30-ton load.

KEWANEE FLANGE UNION.

The Kewanee flange union, one of the valuable applications of the Kewanee principle, is here illustrated in section and shows the construction of the brass to iron self-seating ball joint, which can always be made tight without a gasket. Considerable loss may result from the blowing out of a gasket, which is prevented in this gasket.



Kewanee Flange Union.

The construction is compact, light in weight, designed to combine strength with rigidity. In addition, the flange is loose on the collar, and the bolts match the holes in any position of the flange.

This brief outline may suffice for those who use this class of material, and if followed by a call at booth 28, of the National Tube Company, Pittsburgh, Pa., any questions regarding the Kewanee unions may be thoroughly covered and understood.

THE NEW TYPE K, GROUND OPERATED KENNICOTT WATER SOFTENER.

"From the ground up," is the reason why the Kennicott Water Softener Company, Chicago, finds that railway men like their new type K machine, since it is operated in this way. Where this apparatus is installed, it is not necessary for the attendant to climb to the top of the machine, as the operating room, reagent tanks and chemical storage are conveniently placed and safely housed at the base of the one single tank which the Kennicott machine requires.

Like all really new and noteworthy inventions, the Kennicott type K softener is, both in construction and operation, surprisingly simple. The chemicals are apportioned in a regulating tank to the amount of water entering the machine. This tank is placed adjoining the mixing tank on the ground. This receives from the hard water box at the top of the machine a small stream of water, directly proportioned to the amount of water flowing into the softener. In turn it regulates the lift-pipe, located in a chemical tank, the contents of which are constantly agitated. This lift-pipe discharges the chemicals into a small pump, where they are diluted with softened water and then elevated, by means of a centrifugal pump, to the top of the machine for mixing with the incoming raw water. The raw water, accurately mixed with the chemicals, then passes down and up through the settling tank and is discharged at the top, bright, clear and soft. In this the water follows the same course in precipitation and filtration that has proven so efficient in the previous Kennicott machines.

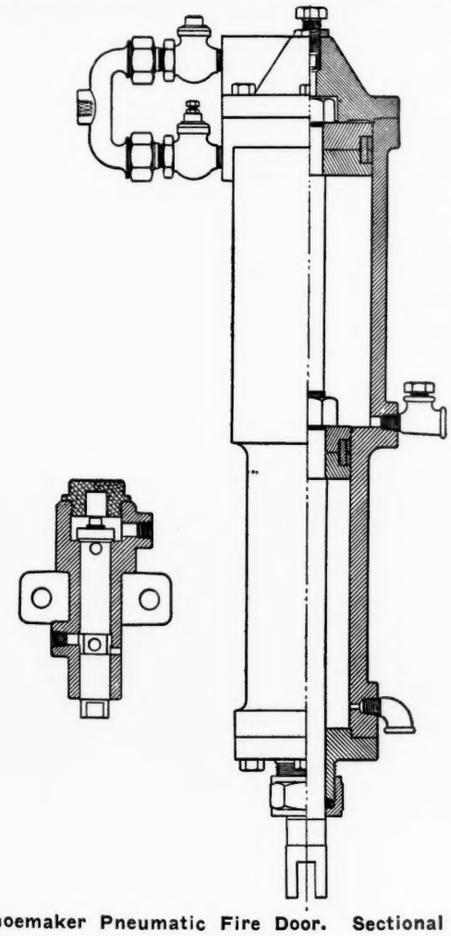
Besides the improvement in case of handling, many other unique features of merit distinguish the Kennicott type K softener. The conical down-take steadily reduces the speed of flow and thus insures perfect and complete sedimentation; the separation of the sludge is aided not only by the action of gravity, but by the direction of the water current; the sludge is blown off by a specially devised and peculiarly efficient spider and the water passes through the filter at the very lowest rate of flow. In very large machines the loss of

head is only about three feet. There are no moving parts at the top to get out of order, and as the chemical solution is continually diluted with soft water, the chemical pipes never clog. There are no reciprocating parts to wear or become displaced, and the very few moving parts all have a rotary motion.

The original Kennicott type A machine is a good water softener. It is said to have been the first device of its kind to come into general use, and the large number of these machines which were purchased by the leading railways are still in service. The Kennicott type B, and the other types which were successively devised by the large corps of water softener specialists maintained by this company, both here and abroad, is also an effective machine. In type K, however, the Kennicott Company confidently asserts that it has the most simple, effective and convenient apparatus for softening water ever devised.

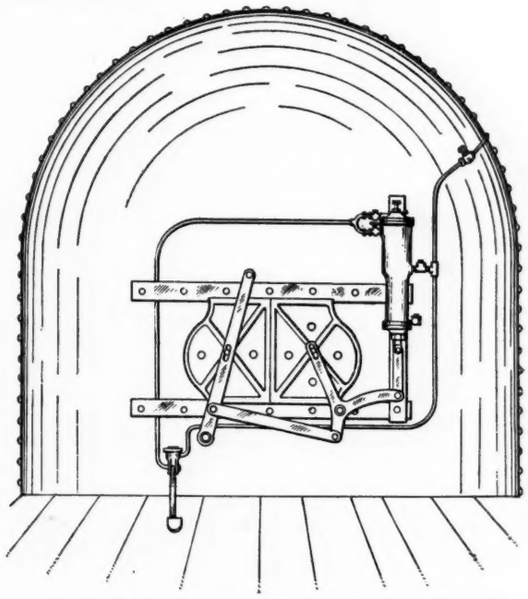
THE SHOEMAKER PNEUMATIC FIRE DOOR OPERATOR.

The Shoemaker firebox door operator is a device which accomplishes the desired result in a simpler and surer manner than other similar devices on the market. It differs from the other automatic firebox door operators in not having double cylinders for opening and closing the door, and it has no spring movement to close the door. The improved device



The Shoemaker Pneumatic Fire Door. Sectional View of Air Cylinder.

here illustrated opens and closes the door with a single cylinder fitted with a differential piston and no springs are used in connection with it. The door is opened and closed in a uniform length of time, regardless of the air pressure carried, and is so designed that the action is cushioned so as not to permit slamming and possibly consequent breaking of the doors. The strong claim for this door operator is its simplicity of design, permanence of action and material reduction of firemen's labor.



Front View, Shoemaker Pneumatic Fire Door.

It is supplied by the National Railway Devices Company, 400 Old Colony building, Chicago, and is on exhibition at booth 319, Young's Million Dollar Pier.

GLYCO METAL IN RAILWAY PRACTICE.

All tin and bronze alloys have the commercial drawback of being more expensive than a lead-base alloy and are subject to violent fluctuations in price. Trials have been made in the past to substitute a lead-base alloy for these higher priced metals, but with little success. The invention of Glyco metal has, however, entirely changed the situation because of its superior properties. Glyco has succeeded because its composition and process of preparation are peculiar and unique and give it properties which no other lead-base metal has ever been able to secure. Uniformity, freedom from segregation, low co-efficient of friction, diminished heating properties,

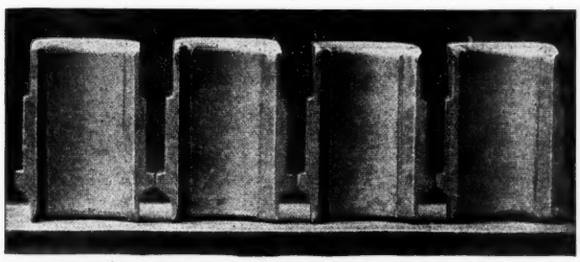


Fig. 1—Glyco Lined Car Journal Bearings.
Photographed after having run 174,000 *miles*

fluidity, freedom from dross, are among the qualities which are claimed for Glyco.

Joseph T. Ryerson & Son, Chicago, make four different grades of Glyco metal, which are adapted to various kinds of service. The grades are: Turbo Glyco, Marine Glyco, Standard Glyco and Transmission Glyco. The standard grade is the one especially recommended for use in car journal bearings, while for such service as crank pin bearings of locomotives they recommend Marine or Turbo, depending on the special conditions.

Turbo Glyco is the highest grade and was designed to withstand very hard service.

Since its inception Glyco metal has been closely indentified with the railway trade, being used as a standard metal by the

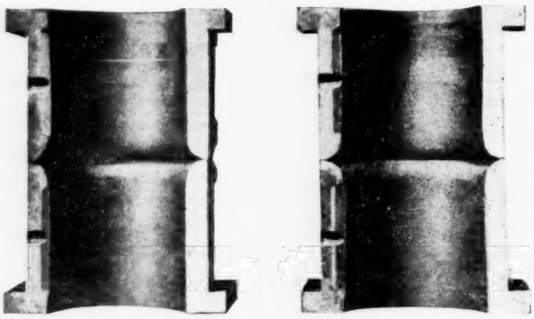


Fig. 2—Side Pin Bearings; Prussian State Railways Locomotives.

Prussian State Railways, after exhaustive trials. These railways were among the first to adopt Glyco metal and since that time numerous other roads have used it extensively. Glyco metal may be used as a liner for M. C. B. standard journal

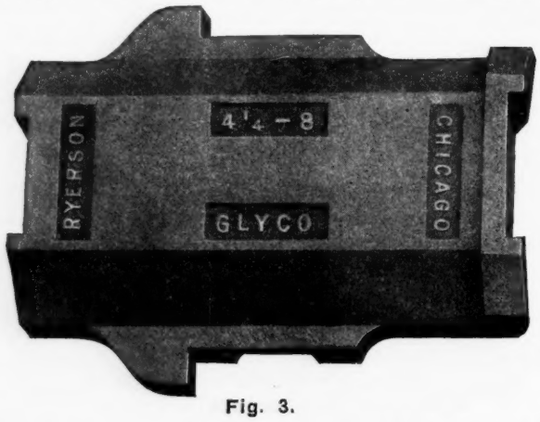


Fig. 3.

bearing, for lining locomotive connecting-rod bearings, driving boxes and cross-head shoes.

As an illustration of the application of Glyco metal to locomotive bearings, an accompanying cut shows the left and right side bearing shells for the side pins of a Prussian State Rail-

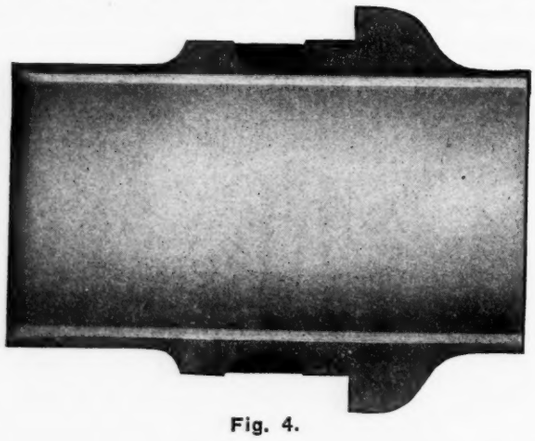


Fig. 4.

ways freight locomotive. Dimensions of the engine are: Diameter of cylinders, 17¾ in.; stroke, 24¾ in.; steam pressure, 180 lbs.; side pins, 4 in. x 4 in. The maximum pressure on these bearings is 2,700 lbs. per sq. in. After a mileage of 23,200 miles, the bearings, being still in good condition, were put back into service. These were bronze shells, tinned, then lined with Marine Glyco.

The firm strongly recommends the employment of a white metal liner for a brass or bronze car journal bearing, thus relieving the journal itself of the attacking influence and frictional resistance of the brass. It is well known that the brass part of a car journal bearing is exceedingly variable in its character and quality and many times is totally unfit to come into direct contact with the journal. The employment of Glyco metal as a liner is claimed to give increased life to the bearing, reduce hot-boxes to the minimum, avoid injury to the journal and reduce friction. The importance of securing a plastic white metal liner, calculated to relieve friction and take the wear off the journal, cann t be over-estimated and the absolute and unvarying homogeneity and uniformity of Glyco place it, for this branch of service, in the unique position of being an unquestioned standard.

The firm therefore recommends that Glyco metal be specified as a bearing liner, whether it supplies the finished bearing or the ingot material. It is prepared to furnish Glyco-lined car journal bearings in the four M. C. B. standard sizes, viz:

3¾	in. x	7	in. approximate weight, each	.....	10 lbs.
4¼	" x	8	" " "	.....	13 "
5	" x	9	" " "	.....	20 "
5½	" x	10	" " "	.....	25 "

Fig. 3 shows a view of the back of the bearing, which is made of bronze or brass of any desired specification. Fig. 4

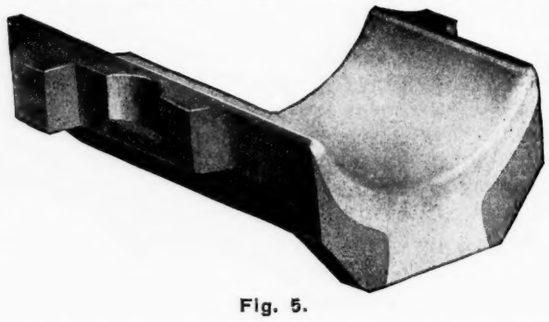


Fig. 5.

shows a front view of the Glyco bearing surface, which, it will be noted, is very smoothly cast and presents a fine surface to the journal.

Fig. 5 presents an end view and illustrates a special feature of the construction of Glyco bearings, i.e., an alternating field of Glyco and bronze in the flange ends. The purpose and advantage of this Glyco field is to smoothen and polish the axle collar and decrease friction, while the bronze resists the shocks and pressures. It is a well known fact that the wear on the flange is very high, and whatever will reduce this will thus lengthen the life of the bearing.

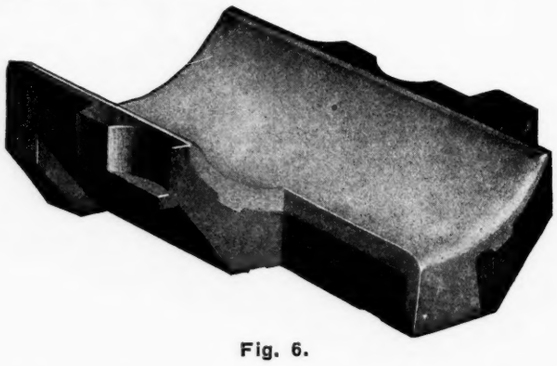


Fig. 6.

Fig. 6 shows a sectional view of the Glyco bearing, which is reproduced in order to show the intimate contact obtained in the casting of the Glyco liner with the bronze back. Such a result is of the greatest importance, as this intimate fusion or soldering together makes a bearing of the highest possible efficiency in rapidly conducting away from the bearing surface the heat generated by friction.

A full stock of Glyco bearings and Glyco metal in ingots is carried on hand for prompt shipment.